

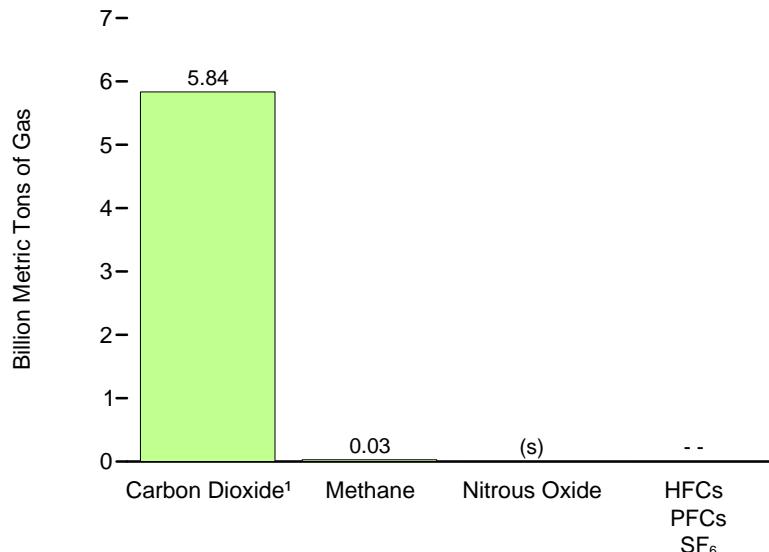
# Environment



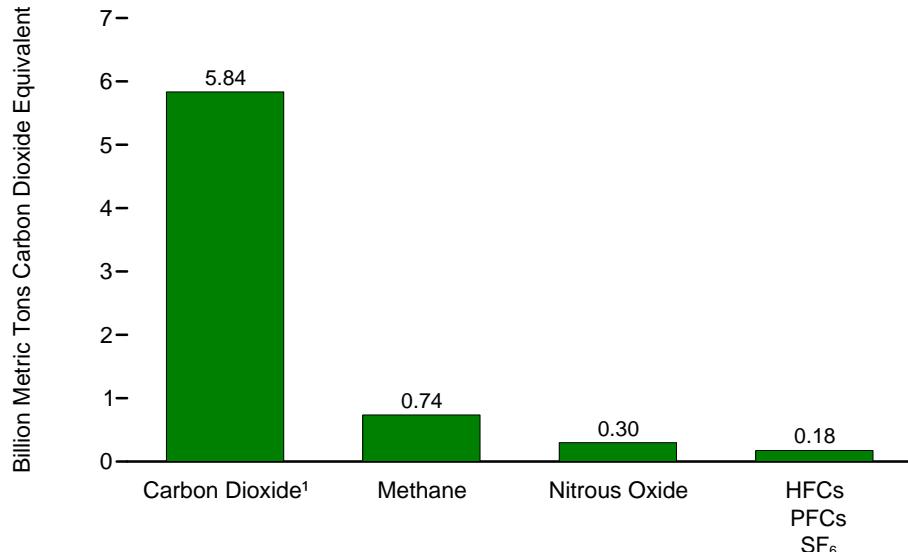
"Harpers Ferry, Junction of the Rivers Shenandoah and Potomac." Engraving by W. Goodacre and James Archer, published in *The History and Topography of the United States of North America*, by John Howard Hinton, 1852. From the collection of the National Park Service, Harpers Ferry National Historical Park, Accession #1297.

**Figure 12.1 Emissions of Greenhouse Gases**

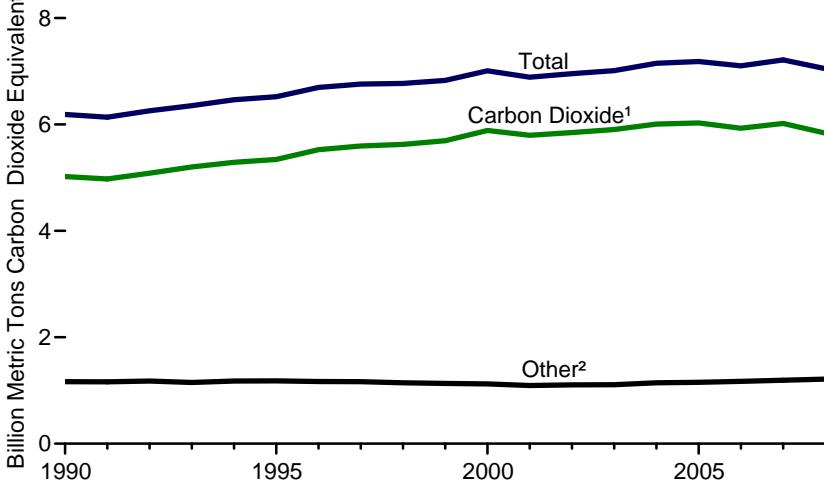
**By Type of Gas, 2008**



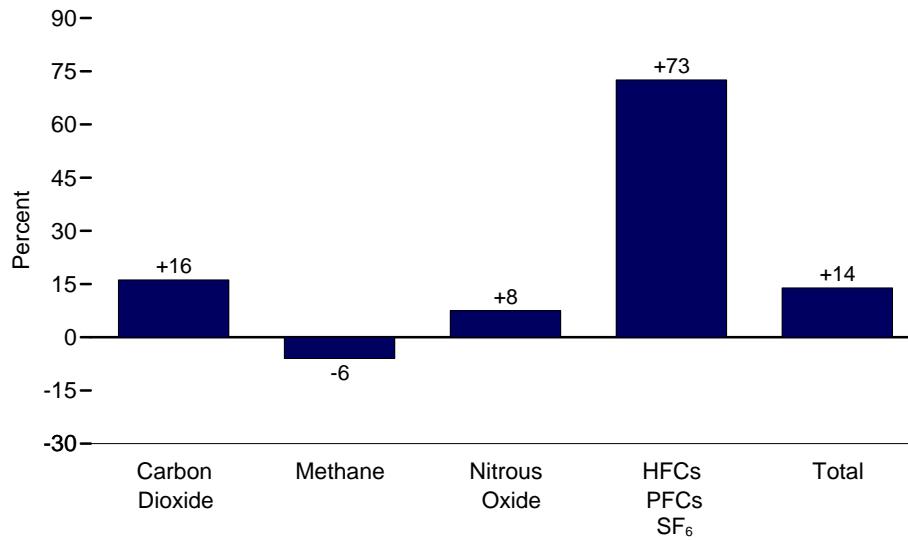
**Based on Global Warming Potential, by Type of Gas, 2008**



**Based on Global Warming Potential, 1990-2008**



**Change 1990-2008, Based on Global Warming Potential**



<sup>1</sup> Metric tons of carbon dioxide can be converted to metric tons of carbon equivalent by multiplying by 12/44.

<sup>2</sup> Methane, nitrous oxide, HFCs, PFCs, and SF<sub>6</sub>.

(s)=Less than 0.005 billion metric tons of gas.

-- = Not applicable because these gases cannot be summed in native units.

Notes: • HFCs=hydrofluorocarbons; PFCs=perfluorocarbons; and SF<sub>6</sub>=sulfur hexafluoride.

• Emissions by type of gas should not be compared; for comparison, see emissions based on global warming potential by type of gas.

Source: Table 12.1.

**Table 12.1 Emissions of Greenhouse Gases, 1990-2008**

Year	Greenhouse Gases							Greenhouse Gases, Based on Global Warming Potential <sup>1</sup>					
	Carbon Dioxide <sup>2,3</sup>					Methane	Nitrous Oxide	HFCs PFCs SF <sub>6</sub>	Carbon Dioxide <sup>2</sup>	Methane	Nitrous Oxide	HFCs PFCs SF <sub>6</sub>	Total
	Energy Related <sup>4</sup>	U.S. Territories <sup>5</sup>	Bunker Fuels <sup>6</sup>	Other Sources <sup>7</sup>	Total								
Million Metric Tons of Gas												Million Metric Tons Carbon Dioxide Equivalent <sup>2</sup>	
1990	5,020	32	-114	85	R5,022	31.3	R0.9	--	R5,022	R784	R279	R102	R6,187
1991	4,975	36	-121	86	R4,976	R31.2	R1.0	--	R4,976	R781	R288	R93	R6,138
1992	5,069	36	-111	88	R5,083	R31.4	R1.0	--	R5,083	R785	R293	R98	R6,258
1993	5,172	38	-100	94	R5,203	R30.4	R1.0	--	R5,203	R760	R293	R97	R6,353
1994	5,251	41	-99	97	R5,290	R30.5	R1.1	--	R5,290	R763	R314	R100	R6,466
1995	5,302	39	-102	102	R5,342	R30.2	R1.0	--	R5,342	R756	R306	R119	R6,522
1996	5,488	38	-103	104	R5,526	R29.3	R1.0	--	R5,526	R731	R308	R130	R6,695
1997	5,562	39	-111	104	R5,595	29.2	R1.0	--	R5,595	R729	R298	R137	R6,759
1998	5,605	41	-116	96	R5,627	R27.8	R1.0	--	R5,627	R696	R297	R152	R6,772
1999	5,665	41	-108	97	R5,695	27.6	R1.0	--	R5,695	R690	R294	R149	R6,829
2000	5,850	43	-104	98	R5,886	R27.3	R1.0	--	R5,886	R683	R290	R151	R7,010
2001	5,745	54	-100	97	R5,797	R26.7	R1.0	--	R5,797	R669	R286	R138	R6,888
2002	5,790	53	-92	98	R5,849	R26.9	R1.0	--	R5,849	R673	R284	R148	R6,954
2003	5,835	57	-86	99	R5,905	R27.3	R.9	--	R5,905	R682	R283	R142	R7,012
2004	5,952	61	-105	102	R6,009	R27.5	R1.0	--	R6,009	R687	R302	R154	R7,151
2005	5,973	58	-107	103	R6,028	R27.7	R1.0	--	R6,028	R692	R304	R158	R7,182
2006	5,894	58	-129	106	R5,929	R28.3	R1.0	--	R5,929	R706	R305	R161	R7,101
2007	5,990	55	-130	106	R6,020	R28.9	R1.0	--	R6,020	R723	R300	R170	R7,213
2008	5,810	48	-127	104	5,835	29.5	1.0	--	5,835	737	300	176	7,049

<sup>1</sup> Emissions of greenhouse gases are weighted based upon their relative global warming potential (GWP), with carbon dioxide equal to a weight of one. See "Global Warming Potential" in Glossary.

<sup>2</sup> Metric tons of carbon dioxide can be converted to metric tons of carbon equivalent by multiplying by 12/44.

<sup>3</sup> Carbon dioxide data in this table differ from those for the United States in Table 11.19 because data in this table: include emissions from electric power sector use of geothermal energy and non-biomass waste; include emissions from the U.S. Territories; include emissions from cement manufacture, limestone consumption, natural gas production, and other sources; and exclude emissions from bunker fuels.

<sup>4</sup> U.S. carbon dioxide emissions from: fossil fuel combustion; the nonfuel use of fossil fuels; and electric power sector use of geothermal energy and non-biomass waste. Geographic coverage is the 50 States and the District of Columbia.

<sup>5</sup> U.S. Territories' energy-related carbon dioxide emissions. Geographic coverage is American Samoa, Guam, Puerto Rico, U.S. Pacific Islands, U.S. Virgin Islands, and Wake Island. According to the "United Nations Framework on Climate Change" (UNFCCC), emissions from the U.S. Territories are included in the U.S. inventory.

<sup>6</sup> U.S. carbon dioxide emissions from bunker fuels (marine, aviation, and military). According to the UNFCCC, emissions from bunker fuels are excluded from the U.S. inventory.

<sup>7</sup> U.S. carbon dioxide emissions from: cement manufacture; limestone consumption; flaring of natural gas at the wellhead, and carbon dioxide scrubbed from natural gas; soda ash manufacture and consumption; carbon dioxide manufacture; aluminum manufacture; shale oil production; and waste

combustion in the commercial and industrial sectors.

R=Revised. -- = Not applicable because these gases cannot be summed in native units.

Notes: • HFCs = hydrofluorocarbons; PFCs = perfluorocarbons; and SF<sub>6</sub> = sulfur hexafluoride.

- Emissions are from anthropogenic sources. "Anthropogenic" means produced as the result of human activities, including emissions from agricultural activity and domestic livestock. Emissions from natural sources, such as wetlands and wild animals, are not included.
- Because of the continuing goal to improve estimation methods for greenhouse gases, data are frequently revised on an annual basis in keeping with the latest findings of the international scientific community. Revisions reflect updates to GWP estimates, as well as to energy consumption data and updated emission factors, where applicable.
- For information on units for measuring greenhouse gases, see [http://www.eia.gov/oiaf/1605/grprt/pdf/0573\(2008\).pdf](http://www.eia.gov/oiaf/1605/grprt/pdf/0573(2008).pdf), page 12, box titled "Units for Measuring Greenhouse Gases."
- See Note, "Accounting for Carbon Dioxide Emissions From Biomass Energy Combustion," at end of section.
- Totals may not equal sum of components due to independent rounding.

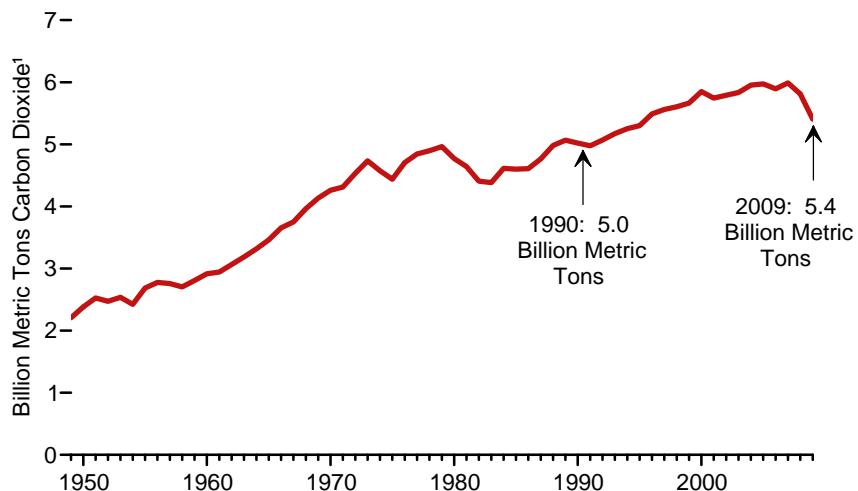
Web Page: For related information, see <http://www.eia.gov/environment.html>.

Sources: **Energy-Related Carbon Dioxide:** Table 12.2. **Total Carbon Dioxide (columns 5 and 9):**

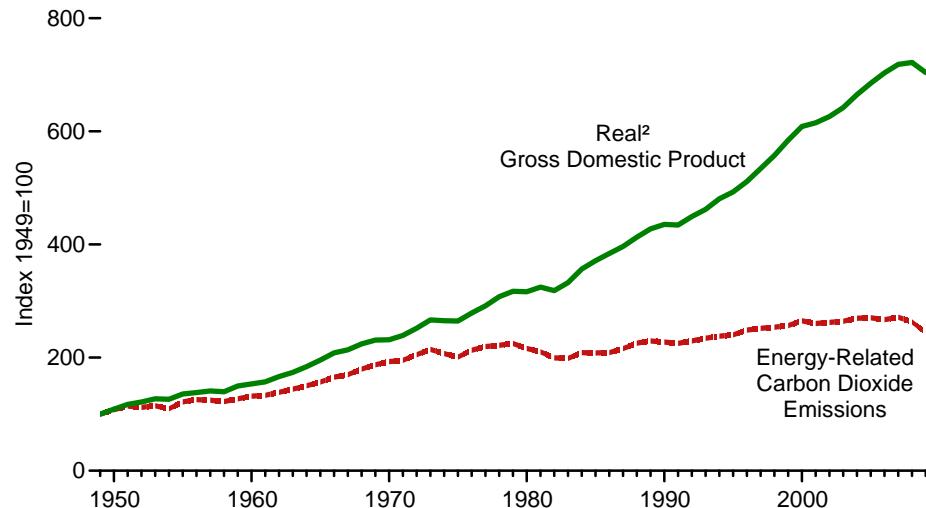
Calculated as the sum of columns 1-4. **Methane (column 6):** Table 12.5. **Nitrous Oxide (column 7):** Table 12.6. **Total Greenhouse Gases:** Calculated as the sum of columns 9-12. **All Other Data:** U.S. Energy Information Administration (EIA), *Emissions of Greenhouse Gases in the United States 2008* (December 2009), Tables 1, 14, and 15.

**Figure 12.2 Carbon Dioxide Emissions From Energy Consumption**

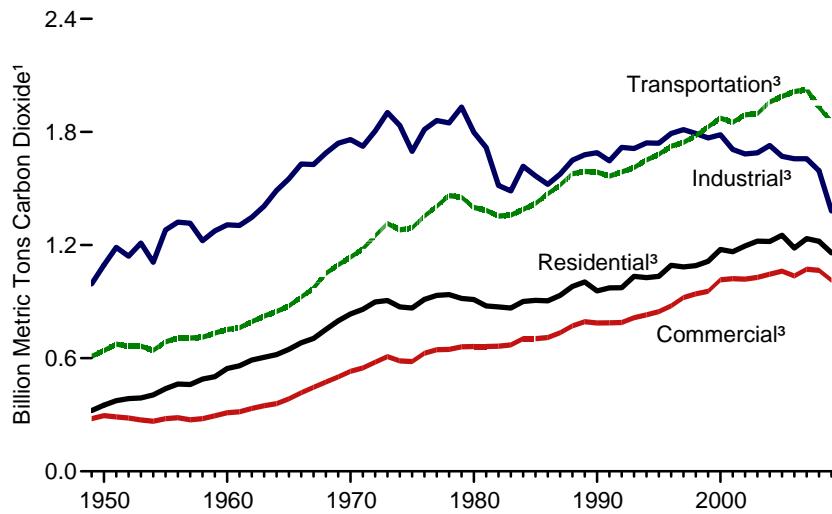
**Total (All Sectors), 1949-2009**



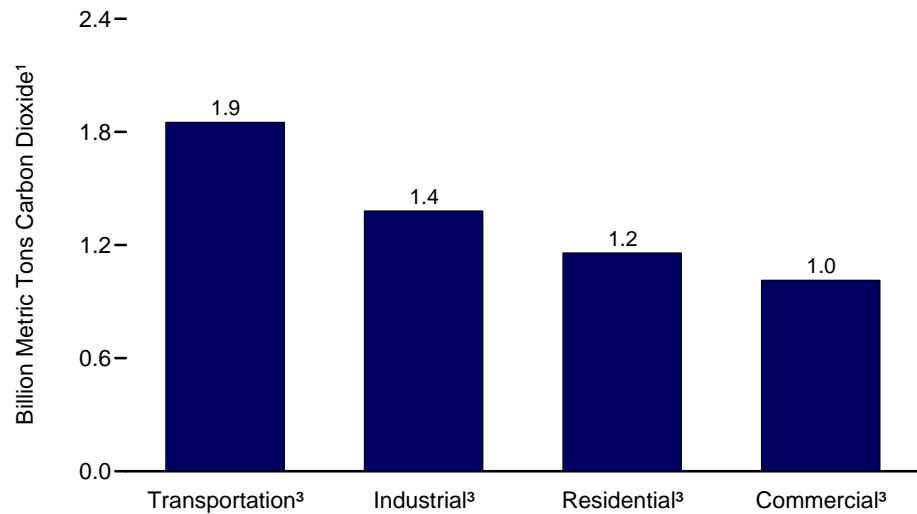
**Economic Growth and Carbon Dioxide Emissions, 1949-2009**



**By End-Use Sector, 1949-2009**



**By End-Use Sector, 2009**



<sup>1</sup> Metric tons of carbon dioxide can be converted to metric tons of carbon equivalent by multiplying by 12/44.

<sup>2</sup> Based on chained (2005) dollars.

<sup>3</sup> Electric power sector emissions are allocated to end-use sectors in proportion to each sector's share of total electricity retail sales (see Tables 8.9 and 12.2).

Sources: Tables 1.5, 12.2, and 12.3.

**Table 12.2 Carbon Dioxide Emissions From Energy Consumption: Total (All Sectors) and Electric Power Sector, Selected Years, 1949-2009** (Million Metric Tons of Carbon Dioxide <sup>1</sup>)

Year	Total (All Sectors)				Electric Power Sector					
	Coal <sup>2</sup>	Natural Gas <sup>3</sup>	Petroleum <sup>4</sup>	Total <sup>5</sup>	Coal	Natural Gas <sup>3</sup>	Petroleum <sup>4</sup>	Geothermal	Non-Biomass Waste <sup>6</sup>	Total
1949	1,118	270	820	2,207	187	30	33	NA	NA	250
1950	1,152	313	918	2,382	206	35	37	NA	NA	278
1955	1,038	472	1,175	2,685	324	63	37	NA	NA	424
1960	915	650	1,349	2,914	396	95	43	NA	NA	535
1965	1,075	828	1,559	3,462	546	127	57	NA	NA	730
1970	1,134	1,144	1,983	4,261	678	215	166	NA	NA	1,059
1971	1,076	1,180	2,056	4,312	684	217	196	NA	NA	1,098
1972	1,121	1,192	2,219	4,532	732	217	243	NA	NA	1,192
1973	1,207	1,181	2,346	4,733	812	199	276	NA	NA	1,286
1974	1,185	1,140	2,248	4,574	800	187	264	NA	NA	1,251
1975	1,181	1,047	2,209	4,437	824	172	248	NA	NA	1,244
1976	1,266	1,068	2,372	4,705	911	167	273	NA	NA	1,351
1977	1,300	1,046	2,500	4,846	962	174	306	NA	NA	1,442
1978	1,298	1,050	2,548	4,896	960	175	313	NA	NA	1,448
1979	1,410	1,085	2,469	4,964	1,056	192	258	NA	NA	1,505
1980	1,436	1,063	2,272	4,770	1,137	200	207	NA	NA	1,544
1981	1,485	1,036	2,122	4,642	1,180	198	173	NA	NA	1,551
1982	1,433	963	2,011	4,406	1,182	176	123	NA	NA	1,481
1983	1,488	901	1,995	4,383	1,242	158	121	NA	NA	1,521
1984	1,598	962	2,053	4,613	1,318	170	101	NA	NA	1,588
1985	1,638	926	2,035	4,600	1,367	166	86	NA	NA	1,619
1986	1,617	866	2,125	4,608	1,357	142	114	NA	NA	1,613
1987	1,691	920	2,152	4,764	1,427	155	99	NA	NA	1,680
1988	1,775	962	2,246	4,982	1,492	143	123	NA	NA	1,758
1989	1,795	1,022	2,246	5,067	1,519	168	134	(s)	4	1,826
1990	1,803	1,025	2,186	5,020	1,531	176	102	(s)	6	1,815
1991	1,788	1,047	2,133	4,975	1,531	179	95	(s)	7	1,812
1992	1,802	1,082	2,176	5,069	1,551	186	79	(s)	8	1,825
1993	1,870	1,110	2,184	5,172	1,621	188	90	(s)	9	1,907
1994	1,881	1,134	2,226	5,251	1,628	211	84	(s)	9	1,933
1995	1,900	1,184	2,208	5,302	1,649	228	61	(s)	10	1,948
1996	1,982	1,205	2,290	5,488	1,740	205	66	(s)	10	2,020
1997	2,027	1,211	2,313	5,562	1,785	219	75	(s)	10	2,090
1998	2,050	1,189	2,356	5,605	1,815	248	105	(s)	10	2,178
1999	2,046	1,192	2,417	5,665	1,821	260	97	(s)	10	2,189
2000	2,138	1,241	2,461	5,850	1,911	281	91	(s)	10	2,294
2001	2,074	1,187	2,473	5,745	1,856	290	102	(s)	11	2,259
2002	2,077	1,229	2,470	5,790	1,872	306	79	(s)	13	2,271
2003	2,116	1,191	2,517	5,835	1,911	278	98	(s)	11	2,299
2004	2,140	1,194	2,605	5,952	1,923	297	100	(s)	11	2,331
2005	2,161	1,175	2,626	5,973	1,964	319	102	(s)	11	2,397
2006	2,130	1,157	2,595	5,894	1,938	338	56	(s)	12	2,344
2007	2,155	1,235	2,588	5,990	1,971	372	55	(s)	11	2,409
2008	2,122	1,241	2,435	5,810	1,943	362	40	(s)	12	2,357
2009 <sup>p</sup>	1,867	1,221	2,306	5,405	1,733	373	34	(s)	12	2,152

<sup>1</sup> Metric tons of carbon dioxide can be converted to metric tons of carbon equivalent by multiplying by 12/44.

<sup>2</sup> Includes coal coke net imports.

<sup>3</sup> Natural gas, excluding supplemental gaseous fuels.

<sup>4</sup> Petroleum, excluding biofuels.

<sup>5</sup> Includes electric power sector use of geothermal energy and non-biomass waste.

<sup>6</sup> Municipal solid waste from non-biogenic sources, and tire-derived fuels.

P=Preliminary. NA=Not available. (s)=Less than 0.5 million metric tons of carbon dioxide.

Notes: • Data are estimates. • See "Carbon Dioxide" in Glossary. • See Note, "Accounting for

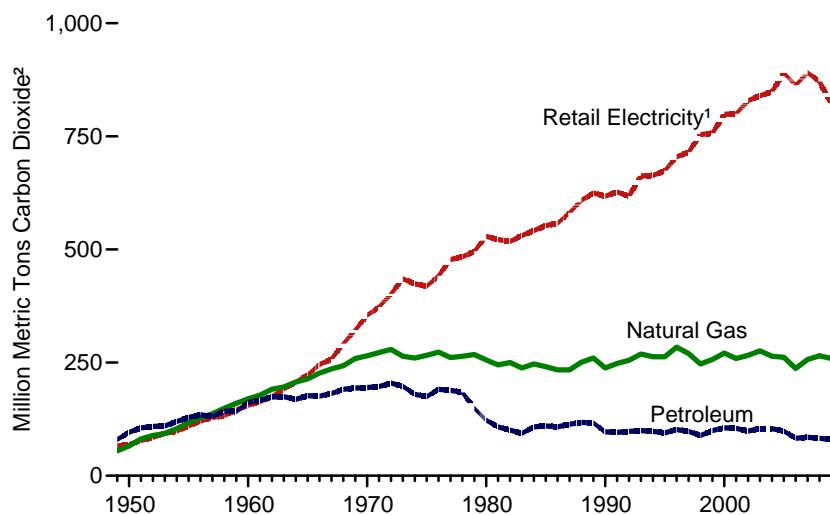
Carbon Dioxide Emissions From Biomass Energy Combustion," at end of section. • Totals may not equal sum of components due to independent rounding.

Web Pages: • For all data beginning in 1949, see <http://www.eia.gov/aer/envir.html>. • For current data, see <http://www.eia.gov/mer/environ.html>. • See <http://www.eia.gov/environment.html> for related information.

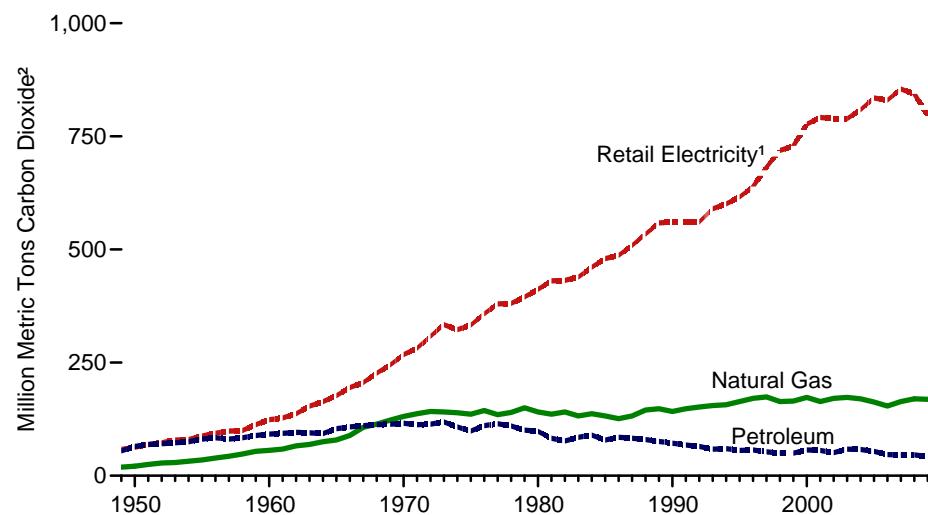
Sources: • 1949-1972—U.S. Energy Information Administration (EIA) estimates based on data in Annual Energy Review Tables 2.1b-2.1f, 5.12, 5.14c, 7.3, 7.7, and A5. • 1973 forward—EIA, Monthly Energy Review (June 2010), Tables 12.1 and 12.6.

**Figure 12.3 Carbon Dioxide Emissions From Energy Consumption by End-Use Sector, 1949-2009**

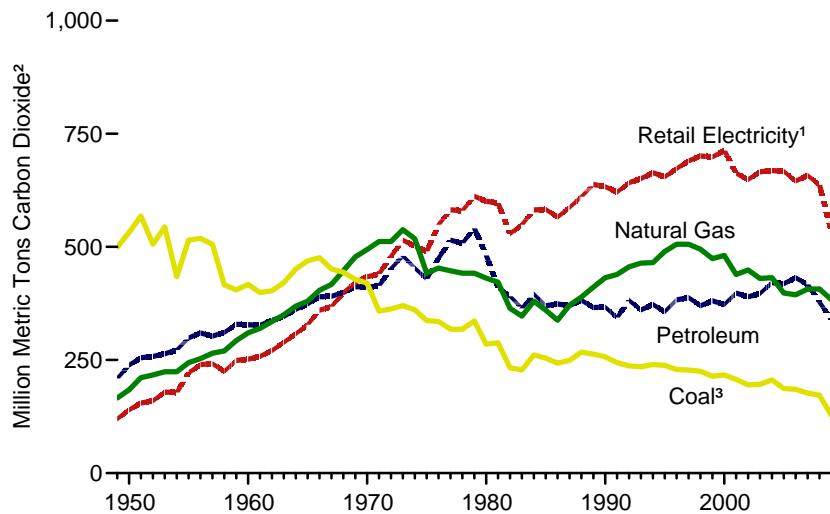
**Residential, by Major Source**



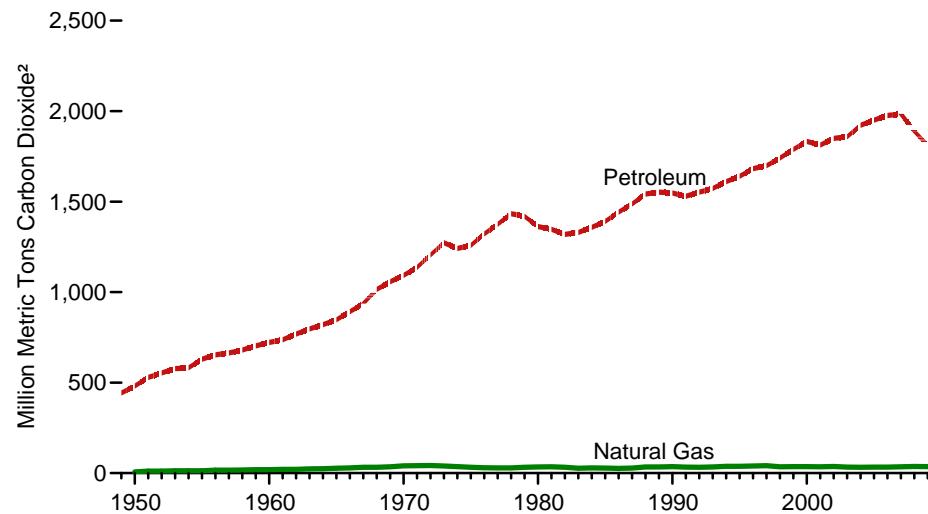
**Commercial, by Major Source**



**Industrial, by Major Source**



**Transportation, by Major Source**



<sup>1</sup> Emissions from energy consumption in the electric power sector are allocated to the end-use sectors in proportion to each sector's share of total electricity retail sales (see Tables 8.9 and 12.2).

<sup>2</sup> Metric tons of carbon dioxide can be converted to metric tons of carbon equivalent by multiplying by 12/44.

<sup>3</sup> Includes coal coke net imports.

Source: Table 12.3.

**Table 12.3 Carbon Dioxide Emissions From Energy Consumption: End-Use Sectors, Selected Years, 1949-2009**  
 (Million Metric Tons of Carbon Dioxide <sup>1</sup>)

Year	Residential					Commercial					Industrial					Transportation				
	Coal	Natural Gas <sup>2</sup>	Petro- leum <sup>3</sup>	Retail Elec- tricity <sup>4</sup>	Total	Coal	Natural Gas <sup>2</sup>	Petro- leum <sup>3</sup>	Retail Elec- tricity <sup>4</sup>	Total	Coal <sup>5</sup>	Natural Gas <sup>2</sup>	Petro- leum <sup>3</sup>	Retail Elec- tricity <sup>4</sup>	Total	Coal	Natural Gas <sup>2</sup>	Petro- leum <sup>3</sup>	Retail Elec- tricity <sup>4</sup>	Total
1949	121	55	80	66	322	148	19	55	58	280	499	166	209	120	994	161	NA	443	6	611
1950	120	66	96	69	351	147	21	65	63	296	532	184	239	140	1,094	146	7	481	6	640
1955	83	117	129	110	438	76	35	81	88	280	515	244	299	222	1,280	39	13	630	5	687
1960	56	170	162	156	545	39	56	92	124	311	417	310	328	252	1,307	7	19	723	2	752
1965	34	214	177	223	647	25	79	104	177	385	469	380	374	328	1,552	1	27	847	2	878
1970	20	265	195	355	835	16	131	116	268	531	420	494	411	434	1,760	1	40	1,093	2	1,136
1971	16	272	197	373	859	17	137	113	282	549	358	512	414	440	1,724	(s)	41	1,137	2	1,180
1972	11	279	205	402	898	15	142	114	308	579	363	512	452	479	1,805	(s)	42	1,205	2	1,250
1973	9	264	198	435	906	15	141	119	334	609	370	538	480	515	1,903	(s)	39	1,273	2	1,315
1974	8	260	180	424	872	17	139	108	323	586	361	518	453	502	1,834	(s)	36	1,242	2	1,281
1975	6	266	175	419	866	14	136	99	333	583	337	442	429	490	1,697	(s)	32	1,258	2	1,291
1976	6	273	191	442	912	14	144	111	358	627	335	453	475	549	1,813	(s)	30	1,322	2	1,354
1977	5	261	189	478	933	14	135	115	380	645	318	447	515	582	1,861	(s)	29	1,375	2	1,406
1978	5	264	184	484	937	16	140	110	381	647	318	442	508	580	1,848	(6)	29	1,433	2	1,463
1979	4	268	149	496	917	14	150	101	395	661	336	442	541	612	1,932	(6)	32	1,419	2	1,454
1980	3	256	123	529	911	11	141	98	412	662	285	431	481	601	1,798	(6)	34	1,363	2	1,400
1981	3	245	108	522	877	13	136	83	431	662	288	422	410	597	1,717	(6)	35	1,348	2	1,385
1982	3	250	101	518	872	15	141	77	432	664	233	364	391	529	1,516	(6)	32	1,319	2	1,354
1983	3	238	94	531	866	15	132	85	439	671	228	347	364	549	1,487	(6)	27	1,330	3	1,359
1984	4	247	108	542	901	16	137	90	461	704	261	380	396	582	1,618	(6)	29	1,358	3	1,390
1985	4	241	110	553	907	13	132	79	480	704	254	360	370	583	1,567	(6)	28	1,391	3	1,421
1986	4	234	108	558	904	13	126	85	487	710	243	338	374	566	1,522	(6)	26	1,442	3	1,472
1987	4	234	114	581	933	12	132	83	509	735	249	371	370	587	1,576	(6)	28	1,487	3	1,519
1988	4	251	118	609	981	12	145	80	534	772	267	389	382	611	1,650	(6)	34	1,542	3	1,579
1989	3	260	117	625	1,004	11	148	76	559	794	263	411	366	638	1,679	(6)	34	1,553	3	1,591
1990	3	238	97	618	957	12	142	72	561	787	257	432	367	633	1,690	(6)	36	1,548	3	1,587
1991	2	248	96	627	973	11	148	68	561	788	244	439	344	621	1,647	(6)	33	1,530	3	1,566
1992	2	255	98	618	974	11	152	65	561	790	237	456	382	642	1,718	(6)	32	1,553	3	1,588
1993	2	269	100	663	1,034	11	155	59	590	815	235	464	361	651	1,712	(6)	34	1,573	3	1,611
1994	2	263	98	664	1,027	11	157	60	601	830	240	465	373	664	1,742	(6)	38	1,611	3	1,652
1995	2	263	95	674	1,034	11	164	56	616	847	238	490	357	655	1,740	(6)	38	1,640	3	1,682
1996	2	284	102	705	1,093	12	171	57	639	878	229	506	383	673	1,792	(6)	39	1,683	3	1,725
1997	2	270	98	715	1,084	12	174	53	682	922	228	506	388	690	1,812	(6)	41	1,699	3	1,744
1998	1	247	89	754	1,091	9	164	50	719	942	225	495	370	701	1,792	(6)	35	1,741	3	1,780
1999	1	257	100	757	1,114	10	165	50	729	955	214	474	381	699	1,768	(6)	36	1,789	3	1,828
2000	1	271	106	799	1,177	9	173	57	777	1,016	217	481	373	713	1,785	(6)	36	1,833	4	1,873
2001	1	259	105	800	1,165	9	164	56	792	1,022	207	439	398	663	1,707	(6)	35	1,813	4	1,851
2002	1	266	99	829	1,195	9	171	51	789	1,020	195	449	390	649	1,683	(6)	37	1,850	4	1,891
2003	1	276	104	840	1,221	8	173	59	789	1,029	196	430	397	666	1,689	(6)	33	1,859	4	1,897
2004	1	264	104	849	1,219	10	170	58	809	1,046	206	432	421	669	1,728	(6)	32	1,922	5	1,959
2005	1	262	99	890	1,252	9	163	54	835	1,062	187	398	419	667	1,671	(6)	33	1,951	5	1,989
2006	1	237	83	863	1,184	6	154	47	830	1,037	185	394	432	646	1,658	(6)	33	1,976	5	2,014
2007	1	257	85	891	1,234	7	164	46	855	1,072	177	407	417	658	1,658	(6)	35	1,985	5	2,025
2008	1	265	83	871	1,220	7	170	46	844	1,066	172	407	378	637	1,594	(6)	37	1,889	5	1,930
2009 <sup>p</sup>	1	259	80	820	1,159	6	169	43	796	1,014	127	383	339	531	1,381	(6)	36	1,810	5	1,851

<sup>1</sup> Metric tons of carbon dioxide can be converted to metric tons of carbon equivalent by multiplying by 12/44.

<sup>2</sup> Natural gas, excluding supplemental gaseous fuels.

<sup>3</sup> Petroleum, excluding biofuels.

<sup>4</sup> Emissions from energy consumption (for electricity and a small amount of useful thermal output) in the electric power sector are allocated to the end-use sectors in proportion to each sector's share of total electricity retail sales. See Tables 8.9 and 12.2.

<sup>5</sup> Includes coal coke net imports.

<sup>6</sup> Beginning in 1978, the small amounts of coal consumed for transportation are reported as industrial sector consumption.

P=Preliminary. NA=Not available. (s)=Less than 0.5 million metric tons of carbon dioxide.

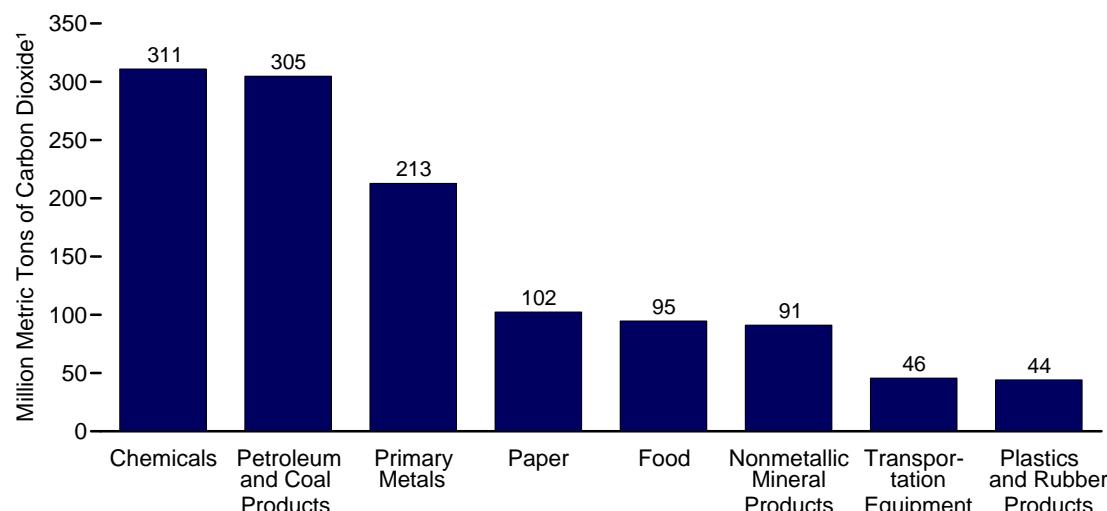
Notes: • Data are estimates. • See "Carbon Dioxide" in Glossary. • See Note, "Accounting for Carbon Dioxide Emissions From Biomass Energy Combustion," at end of section. • Totals may not equal sum of components due to independent rounding.

Web Pages: • For all data beginning in 1949, see <http://www.eia.gov/aer/envir.html>. • For current data, see <http://www.eia.gov/mer/environ.html>. • See <http://www.eia.gov/environment.html> for related information.

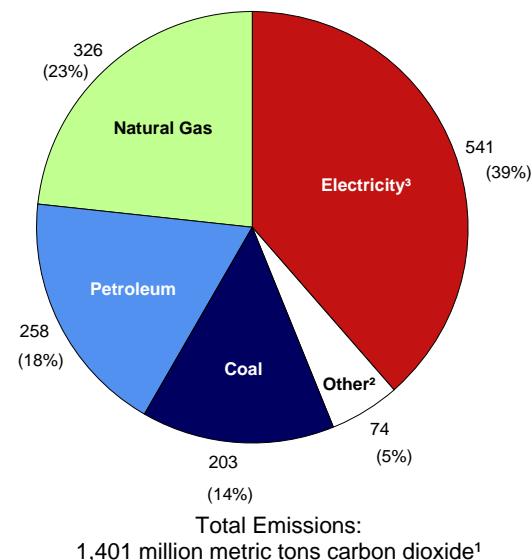
Sources: • 1949-1972—U.S. Energy Information Administration (EIA) estimates based on data in Annual Energy Review Tables 2.1b-2.1f, 5.14a-c, 7.3, 7.7, and A5. • 1973 forward—EIA, *Monthly Energy Review* (June 2010), Tables 12.2-12.5.

**Figure 12.4 Carbon Dioxide Emissions From Consumption of Energy for All Purposes in the Manufacturing Sector, 2002**

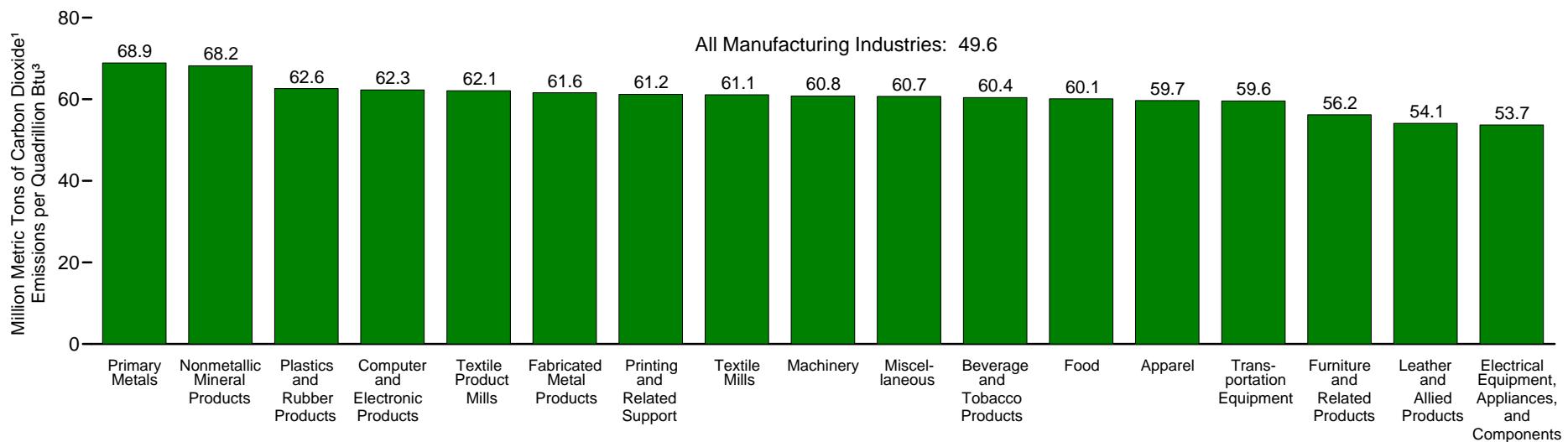
**Carbon Dioxide Emissions by Top Industry Groups**



**Carbon Dioxide Emissions by Energy Source**



**Carbon Dioxide Emissions per Unit of Primary Consumption, Top Industry Groups**



<sup>1</sup> Metric tons of carbon dioxide can be converted to metric tons of carbon equivalent by multiplying by 12/44.

<sup>3</sup> From energy inputs used to produce electricity, including associated losses.  
Source: Table 12.4.

<sup>2</sup> All other types of energy that respondents indicated were consumed or allocated.

**Table 12.4 Carbon Dioxide Emissions From Consumption of Energy for All Purposes in the Manufacturing Sector, 2002**  
 (Million Metric Tons of Carbon Dioxide,<sup>1</sup> Except as Noted)

NAICS <sup>2</sup> Code	Major Group	Carbon Dioxide Emissions						Carbon Dioxide Emissions per Unit of Primary Consumption <sup>5</sup>	Carbon Dioxide Emissions per Real Dollar of Shipments <sup>6</sup>
		Coal	Natural Gas	Petroleum	Electricity <sup>3</sup>	Other <sup>4</sup>	Total		
311	Food .....	17.3	30.7	2.9	43.8	0.1	94.7	60.1	215.2
312	Beverage and Tobacco Products .....	1.6	2.4	0.4	4.9	(s)	9.4	60.4	93.1
313	Textile Mills .....	2.1	4.0	0.6	16.4	0.0	23.0	61.1	518.3
314	Textile Product Mills .....	0.7	1.5	0.3	3.2	0.0	5.8	62.1	170.7
315	Apparel .....	0.0	0.8	0.1	2.3	0.0	3.2	59.7	59.3
316	Leather and Allied Products .....	0.0	0.2	0.0	0.4	0.0	0.6	54.1	59.1
321	Wood Products .....	0.1	3.0	1.2	13.7	0.4	18.4	35.6	205.7
322	Paper .....	22.5	26.6	10.0	42.4	0.8	102.4	36.6	661.3
323	Printing and Related Support .....	0.0	2.4	0.1	9.5	0.0	12.0	61.2	125.9
324	Petroleum and Coal Products .....	19.3	46.4	153.9	24.6	60.8	304.8	43.2	1,301.1
325	Chemicals .....	32.8	106.2	70.2	99.4	2.4	311.0	41.5	738.1
326	Plastics and Rubber Products .....	2.1	6.8	0.9	34.5	(s)	44.2	62.6	249.4
327	Nonmetallic Mineral Products .....	30.1	22.3	11.4	26.8	0.4	91.1	68.2	1,046.0
331	Primary Metals .....	72.4	37.2	2.4	93.8	7.0	212.8	68.9	1,511.1
332	Fabricated Metal Products .....	0.8	11.1	0.9	30.6	0.0	43.4	61.6	173.4
333	Machinery .....	0.1	4.3	0.4	16.0	(s)	20.8	60.8	82.3
334	Computer and Electronic Products .....	0.0	3.4	0.2	24.9	(s)	28.5	62.3	59.9
335	Electrical Equipment, Appliances, and Components .....	0.0	2.8	0.1	8.9	2.3	14.2	53.7	135.3
336	Transportation Equipment .....	1.0	10.7	1.2	32.7	0.1	45.7	59.6	74.1
337	Furniture and Related Products .....	0.1	1.3	0.1	4.6	0.1	6.3	56.2	91.5
339	Miscellaneous .....	0.0	1.7	0.1	6.7	0.0	8.5	60.7	71.7
—	Total Manufacturing .....	202.8	325.9	257.6	540.7	74.2	1,401.2	49.6	352.7

<sup>1</sup> Metric tons of carbon dioxide can be converted to metric tons of carbon equivalent by multiplying by 12/44.

<sup>2</sup> North American Industry Classification System (NAICS).

<sup>3</sup> Carbon dioxide emitted from energy inputs used to produce electricity (including associated losses), derived by calculating the manufacturing subsector share of the electric power sector's total carbon dioxide emissions based upon the weighted share of electricity retail sales to (receipts by) the manufacturing subsector.

<sup>4</sup> Includes all other types of energy that respondents indicated were consumed or allocated, such as asphalt and road oil, lubricants, naphtha < 401° F, other oils >= 401° F, special naphthas, waxes, and miscellaneous nonfuel products, which are nonfuel products assigned to the petroleum refining industry group (NAICS 324110).

<sup>5</sup> Data are in million metric tons of carbon dioxide per quadrillion Btu of energy (including allocated electricity losses).

<sup>6</sup> Data are in metric tons of carbon dioxide per million chained (2000) dollars.

(s)=Less than 0.05 million metric tons.

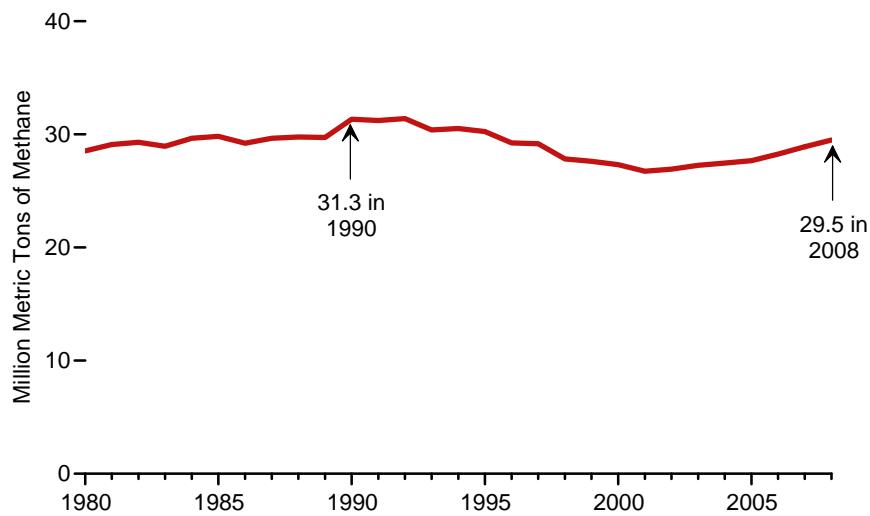
Notes: • Data for this table from the "2006 Manufacturing Energy Consumption Survey" were not available in time for publication. • Data are estimates for the first use of energy for heat and power and as feedstocks or raw material inputs. "First use" is the consumption of energy that was originally produced offsite or was produced onsite from input materials not classified as energy. Minor revisions to the 2002 Manufacturing Energy Consumption Survey (MECS) consumption data have been made since the estimates in this table have been computed. The revisions would likely not have a discernible effect on the estimates shown. • Electricity was converted from point-of-use to primary electricity using Table A6 of this report. • See Table 2.2 for manufacturing energy use. • See Note, "Accounting for Carbon Dioxide Emissions From Biomass Energy Combustion," at end of section. • Totals may not equal sum of components due to independent rounding.

Web Page: For related information, see <http://www.eia.gov/emeu/meecs>.

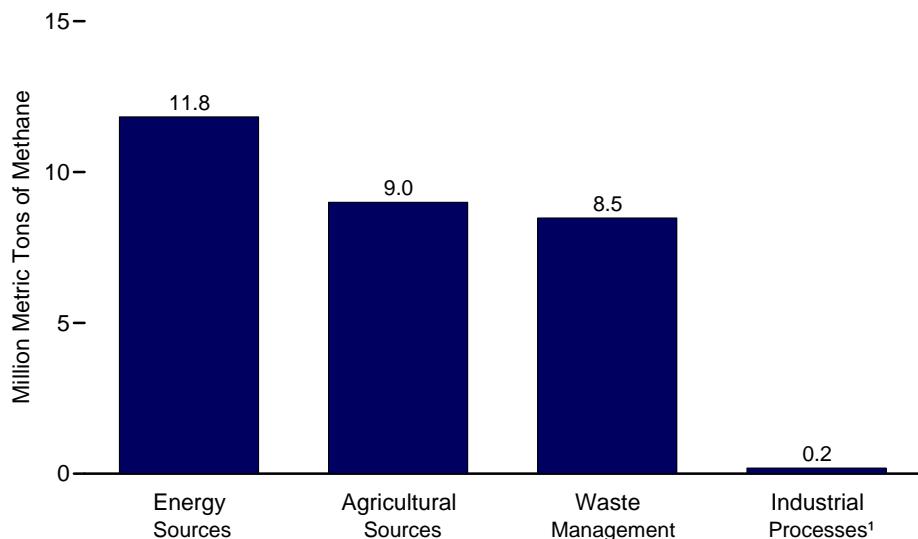
Sources: U.S. Energy Information Administration, Form EIA-846, "2002 Manufacturing Energy Consumption Survey," Form EIA-810, "Monthly Refinery Report" (for 2002), and *Documentation for Emissions of Greenhouse Gases in the United States 2003* (May 2005).

**Figure 12.5 Methane Emissions**

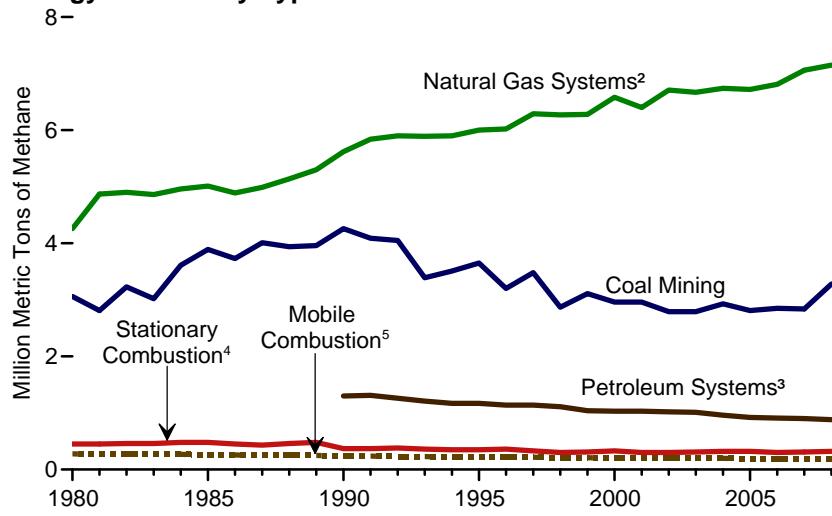
**Total, 1980-2008**



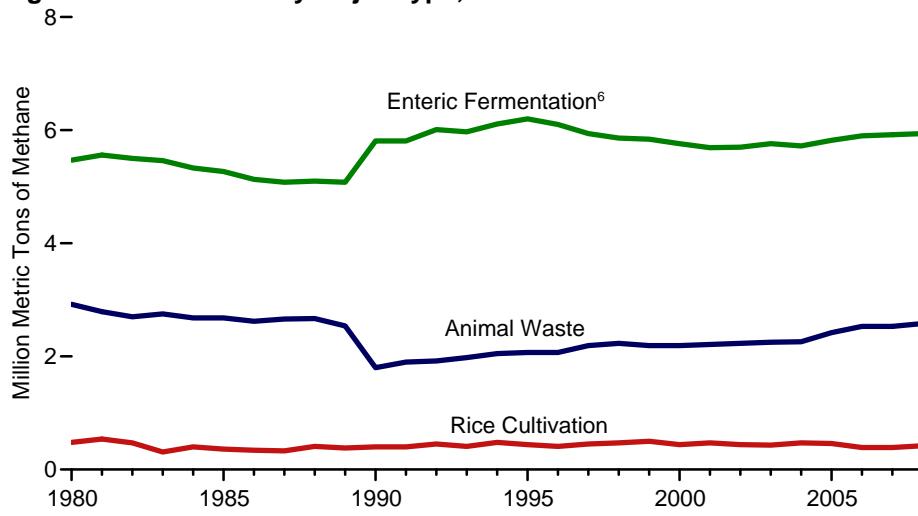
**By Source, 2008**



**Energy Sources by Type 1980-2008**



**Agricultural Sources by Major Type, 1980-2008**



<sup>1</sup> Chemical production, and iron and steel production.

<sup>2</sup> Natural gas production, processing, and distribution.

<sup>3</sup> Petroleum production, refining, and distribution.

<sup>4</sup> Consumption of coal, petroleum, natural gas, and wood for heat or electricity.

<sup>5</sup> Emissions from passenger cars, trucks, buses, motorcycles, and other transport.

<sup>6</sup> Methane emitted as a product of digestion in animals such as cattle, sheep, goats, and swine.

Source: Table 12.5.

**Table 12.5 Methane Emissions, 1980-2008**

(Million Metric Tons of Methane)

Year	Energy Sources					Waste Management			Agricultural Sources					Industrial Processes <sup>9</sup>	Total <sup>5</sup>	
	Coal Mining	Natural Gas Systems <sup>1</sup>	Petroleum Systems <sup>2</sup>	Mobile Combustion <sup>3</sup>	Stationary Combustion <sup>4</sup>	Total <sup>5</sup>	Landfills	Waste-water Treatment <sup>6</sup>	Total <sup>5</sup>	Enteric Fermentation <sup>7</sup>	Animal Waste <sup>8</sup>	Rice Cultivation	Crop Residue Burning			
1980	R3.06	R4.26	NA	0.28	R0.45	R8.04	R10.52	0.52	R11.04	5.47	R2.92	0.48	0.04	R8.91	R0.17	R28.17
1981	R2.81	R4.87	NA	.27	R.45	R8.39	R10.69	.53	R11.22	5.56	R2.79	.54	.05	R8.94	R.18	R28.73
1982	3.23	R4.90	NA	.27	R.46	R8.86	R10.64	.54	R11.17	5.50	R2.70	.47	.05	R8.71	R.13	R28.89
1983	3.02	R4.86	NA	.27	R.46	R8.62	R10.67	.54	R11.21	5.46	R2.75	.31	.03	R8.56	R.15	R28.55
1984	R3.61	R4.96	NA	.27	R.48	R9.31	R10.68	.66	R11.34	5.33	R2.68	.40	.04	R8.45	R.17	R29.27
1985	R3.89	R5.01	NA	.26	R.48	R9.64	R10.65	.67	R11.32	5.27	R2.68	.36	R.04	R8.35	R.16	R29.47
1986	3.73	R4.89	NA	.26	R.45	R9.34	R10.53	R.67	R11.21	5.13	R2.62	.34	.04	R8.13	R.16	R28.84
1987	4.01	R4.99	NA	.25	R.43	R9.70	R10.63	.68	R11.31	5.08	R2.66	.33	.04	R8.11	R.17	R29.29
1988	R3.94	R5.14	NA	.25	R.46	R9.79	R10.52	.69	R11.21	5.10	R2.67	.41	.03	R8.21	R.19	R29.40
1989	3.96	R5.30	NA	.25	R.48	R9.99	R10.44	.70	R11.13	5.08	R2.54	.38	.04	R8.04	R.18	R29.35
1990	4.26	5.62	1.30	.24	R.37	R11.78	R10.41	R.91	R11.32	R5.81	R1.80	.40	.04	R8.06	R.18	R31.34
1991	4.09	5.84	1.31	.24	R.37	R11.84	R10.12	R.93	R11.05	R5.81	R1.90	.40	.04	R8.14	R.19	R31.22
1992	4.05	5.90	R1.26	.23	R.38	R11.83	R9.99	R.95	R10.94	R6.01	R1.92	.45	R.04	R8.43	R.19	R31.40
1993	3.39	5.89	1.21	.23	R.36	R11.08	R9.75	R.96	R10.71	R5.97	R1.98	.41	.04	R8.40	R.20	R30.39
1994	3.51	5.90	R1.17	.22	R.35	R11.17	R9.46	R.98	R10.44	R6.11	R2.05	.48	.05	R8.69	R.21	R30.51
1995	3.65	6.00	1.17	R.22	R.35	R11.39	R8.88	R1.00	R9.87	R6.20	R2.07	.44	.04	R8.76	R.22	R30.25
1996	3.20	6.02	R1.14	R.22	R.36	R10.95	R8.45	R1.01	R9.45	R6.10	R2.07	.41	R.04	R8.62	R.23	R29.25
1997	3.48	6.29	R1.14	R.22	R.33	R11.47	R7.81	R1.02	R8.83	R5.94	R2.19	.45	.05	R8.63	R.24	R29.17
1998	2.87	6.27	1.11	R.21	R.30	R10.77	R7.19	R1.03	R8.22	R5.86	R2.23	.47	.05	R8.60	R.24	R27.83
1999	3.11	6.28	R1.04	R.21	R.31	R10.96	R6.78	R1.05	R7.83	R5.84	R2.19	.50	.05	R8.58	R.25	R27.61
2000	R2.96	6.58	R1.03	.20	R.33	R11.11	R6.49	R1.05	R7.54	R5.76	R2.19	.44	.05	R8.44	R.23	R27.32
2001	2.96	6.40	1.03	R.20	R.30	R10.89	R6.19	R1.05	R7.23	R5.69	R2.21	.47	.05	R8.41	R.20	R26.74
2002	2.79	6.71	1.02	R.20	R.30	R11.02	R6.22	R1.06	R7.28	R5.70	R2.23	.44	R.04	R8.42	R.21	R26.93
2003	R2.79	6.67	1.01	R.20	R.31	R10.98	R6.53	R1.06	R7.59	R5.76	R2.25	.43	.05	R8.48	R.21	R27.26
2004	R2.93	R6.74	R.96	R.20	R.32	R11.15	R6.51	R1.07	R7.58	R5.72	R2.26	.47	R.05	R8.50	R.23	R27.46
2005	2.81	6.72	R.92	R.19	R.32	R10.97	R6.67	R1.08	R7.75	R5.82	2.42	.46	.05	R8.75	R.20	R27.67
2006	R2.85	R6.81	R.91	R.19	R.30	R11.07	R7.01	R1.10	R8.10	R5.90	R2.53	.39	.05	R8.87	R.21	R28.25
2007	2.84	7.06	R.90	R.19	R.31	R11.31	R7.38	R1.11	R8.48	R5.92	R2.53	.39	R.05	R8.90	R.21	R28.91
2008	3.28	7.15	.88	.19	.32	11.83	7.37	1.11	8.48	5.94	2.58	.42	.05	9.00	.19	29.50

<sup>1</sup> Natural gas production, processing, and distribution; processing is not included in 1980 and is incompletely covered in 1981-1989.

<sup>2</sup> Petroleum production, refining, and distribution.

<sup>3</sup> Emissions from passenger cars, trucks, buses, motorcycles, and other transport.

<sup>4</sup> Consumption of coal, petroleum, natural gas, and wood for heat or electricity.

<sup>5</sup> See notes on components for specific coverage, which is inconsistent prior to 1990 in some cases.

<sup>6</sup> 1980-1983, domestic wastewater only; 1984 forward, industrial and domestic wastewater.

<sup>7</sup> Methane emitted as a product of digestion in animals such as cattle, sheep, goats, and swine.

<sup>8</sup> Estimation methods for 1990 forward reflect a shift in waste management away from liquid systems to dry-lot systems, thus lowering emissions.

<sup>9</sup> Chemical production, and iron and steel production.

R=Revised. NA=Not available.

Notes: • Emissions are from anthropogenic sources. "Anthropogenic" means produced as the result of

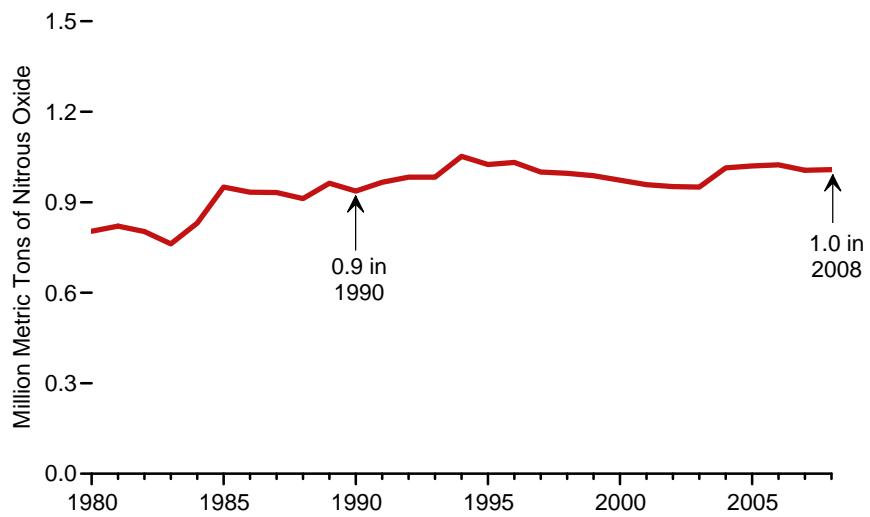
human activities, including emissions from agricultural activity and domestic livestock. Emissions from natural sources, such as wetlands and wild animals, are not included. • Under certain conditions, methane may be produced via anaerobic decomposition of organic materials in landfills, animal wastes, and rice paddies. • Because of the continuing goal to improve estimation methods for greenhouse gases, data are frequently revised on an annual basis in keeping with the latest findings of the international scientific community. • For information on units for measuring greenhouse gases, see <http://www.eia.gov/oiaf/1605/ggrpt/index.html>, Table 4, titled "Greenhouse Gases and 100-Year Net Global Warming Potentials. • Totals may not equal sum of components due to independent rounding.

Web Page: For related information, see <http://www.eia.gov/environment.html>.

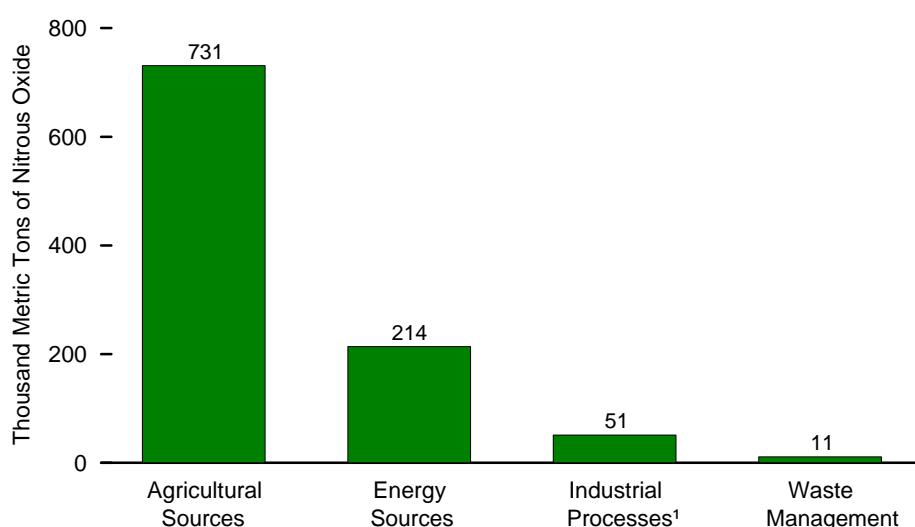
Sources: U.S. Energy Information Administration (EIA), *Emissions of Greenhouse Gases in the United States 2008* (December 2009), Tables 16-20; and EIA, Office of Integrated Analysis and Forecasting, estimates.

**Figure 12.6 Nitrous Oxide Emissions**

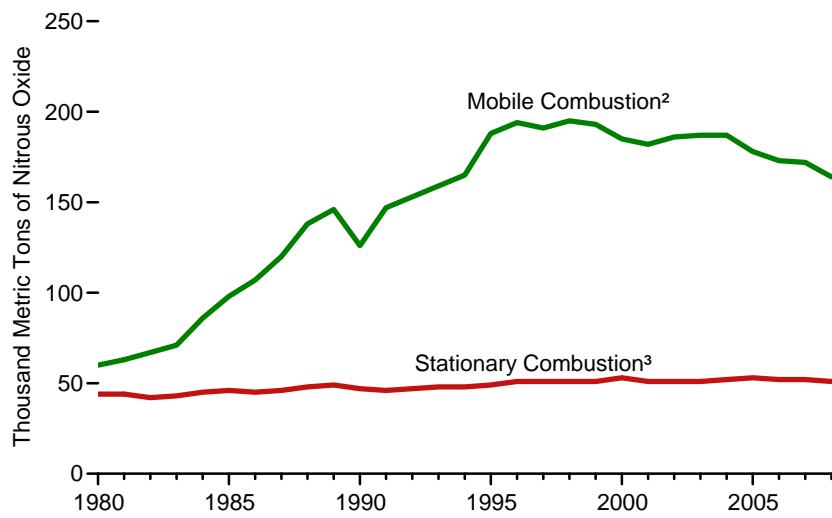
**Total, 1980-2008**



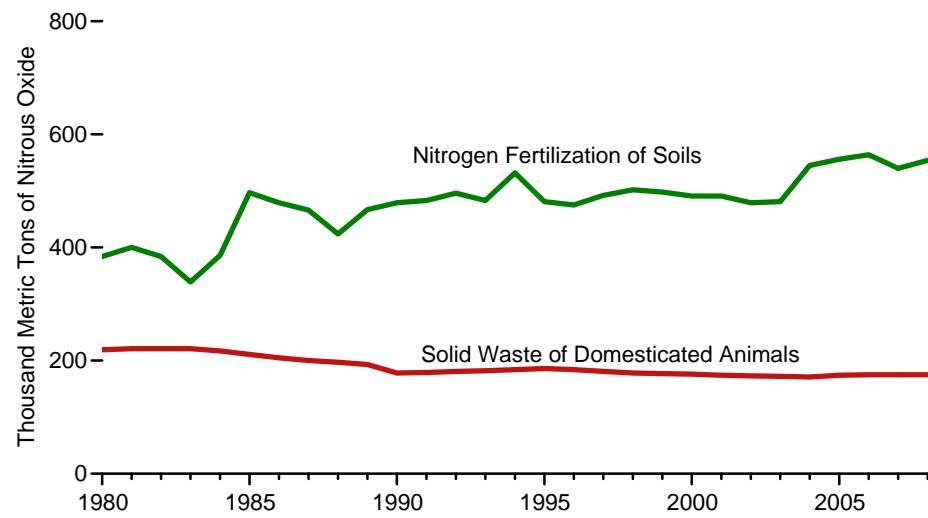
**By Source, 2008**



**Energy Sources by Type, 1980-2008**



**Agricultural Sources by Major Type, 1980-2008**



<sup>1</sup> Adipic acid production (primarily for the manufacture of nylon fibers and plastics) and nitric acid production (primarily for fertilizers).

<sup>2</sup> Emissions from passenger cars and trucks; air, rail, and marine transportation; and farm and construction equipment.

<sup>3</sup> Consumption of coal, petroleum, natural gas, and wood for heat or electricity.  
Source: Table 12.6.

**Table 12.6 Nitrous Oxide Emissions, 1980-2008**

(Thousand Metric Tons of Nitrous Oxide)

Year	Energy Sources			Waste Management			Agricultural Sources				Industrial Processes <sup>3</sup>	Total
	Mobile Combustion <sup>1</sup>	Stationary Combustion <sup>2</sup>	Total	Waste Combustion	Human Sewage in Wastewater	Total	Nitrogen Fertilization of Soils	Crop Residue Burning	Solid Waste of Domesticated Animals	Total		
1980	60	R44	R104	R1	R6	R7	R384	1	R219	R605	88	R804
1981	63	R44	R106	R1	R7	R7	R400	2	R221	R623	85	R821
1982	67	R42	R108	R1	R7	R7	R384	2	R221	R606	81	R803
1983	71	R43	R114	R1	R7	R7	R339	1	R221	R561	80	R762
1984	86	R45	R132	R1	R7	R7	R386	R1	R217	R604	88	R831
1985	98	R46	R143	R1	R7	R8	R497	2	R211	R710	89	R950
1986	107	R45	R152	R1	R7	R8	R479	R1	R205	R685	87	R933
1987	120	R46	R166	1	R7	R8	R466	1	R200	R667	91	R932
1988	138	R48	R185	1	R8	R8	R424	1	R197	R622	96	R912
1989	146	R49	R194	R1	R8	R8	R467	R1	R193	R661	99	R963
1990	126	R47	R173	1	R8	R9	R479	R1	R178	R659	96	R937
1991	147	R46	R193	1	R8	R9	R483	R1	R179	R664	99	R966
1992	153	R47	R200	1	R8	R9	R496	2	R181	R679	95	R983
1993	159	R48	R207	1	R8	R9	R483	1	R182	R666	100	R983
1994	165	R48	R214	1	R9	R10	R532	2	R184	R718	110	R1,052
1995	R188	R49	R236	1	R9	R10	R481	R1	R186	R669	111	R1,025
1996	R194	R51	R245	1	R9	R10	R475	2	R184	R661	116	R1,032
1997	R191	R51	R242	1	R9	R10	R492	2	R181	R675	74	R1,000
1998	R195	R51	R246	1	R9	R10	R502	2	R178	R682	58	R996
1999	R193	R51	R244	1	R9	R10	R498	2	R177	R677	57	R988
2000	R185	R53	R238	1	R9	R10	R491	2	R176	R668	56	R973
2001	R182	R51	R233	1	R10	R11	R491	2	R174	R667	47	R958
2002	R186	R51	R236	1	R10	R11	R479	2	R173	R654	51	R952
2003	R187	R51	R238	1	R10	R11	R481	2	R172	R655	46	R950
2004	R187	R52	R239	1	R10	R11	R545	2	R171	R718	46	R1,014
2005	R178	R53	R231	1	R10	R11	R556	2	R174	R731	47	R1,020
2006	R173	R52	R225	1	R10	R11	R564	2	R175	R741	47	R1,024
2007	R172	R52	R224	1	R10	R11	R540	2	R175	R718	R53	R1,006
2008	164	51	214	1	10	11	554	2	175	731	51	1,008

<sup>1</sup> Emissions from passenger cars and trucks; air, rail, and marine transportation; and farm and construction equipment.

<sup>2</sup> Consumption of coal, petroleum, natural gas, and wood for heat or electricity.

<sup>3</sup> Adipic acid production (primarily for the manufacture of nylon fibers and plastics), and nitric acid production (primarily for fertilizers).

R=Revised.

Notes: • Emissions are from anthropogenic sources. "Anthropogenic" means produced as the result of human activities, including emissions from agricultural activity and domestic livestock. Emissions from natural sources, such as wetlands and wild animals, are not included. • Because of the continuing goal to

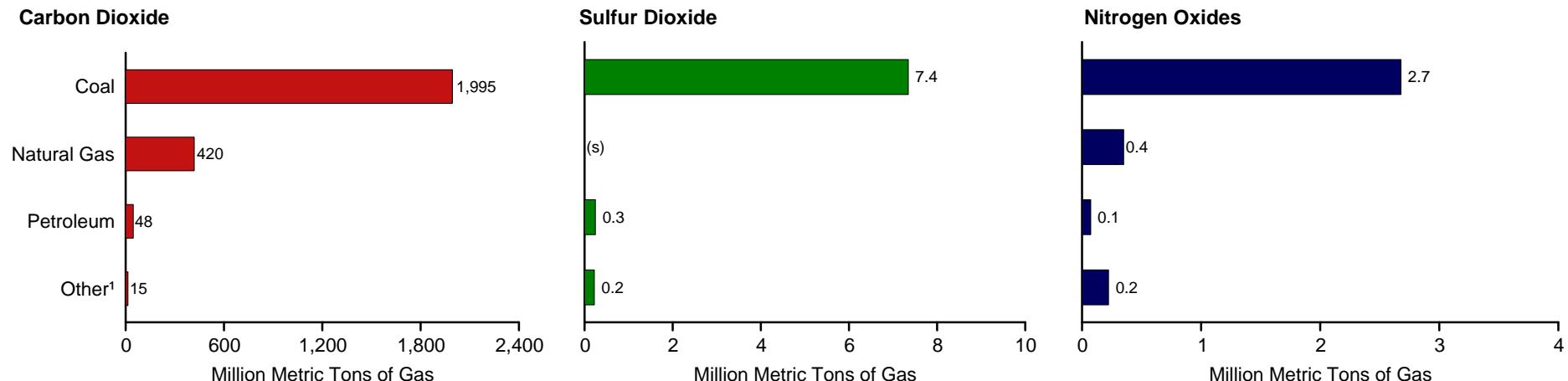
improve estimation methods for greenhouse gases, data are frequently revised on an annual basis in keeping with the latest findings of the international scientific community. • For information on units for measuring greenhouse gases, see <http://www.eia.gov/oiaf/1605/grpt/index.html>, Table 4, titled "Greenhouse Gases and 100-Year Net Global Warming Potentials. • Totals may not equal sum of components due to independent rounding.

Web Page: For related information, see <http://www.eia.gov/environment.html>.

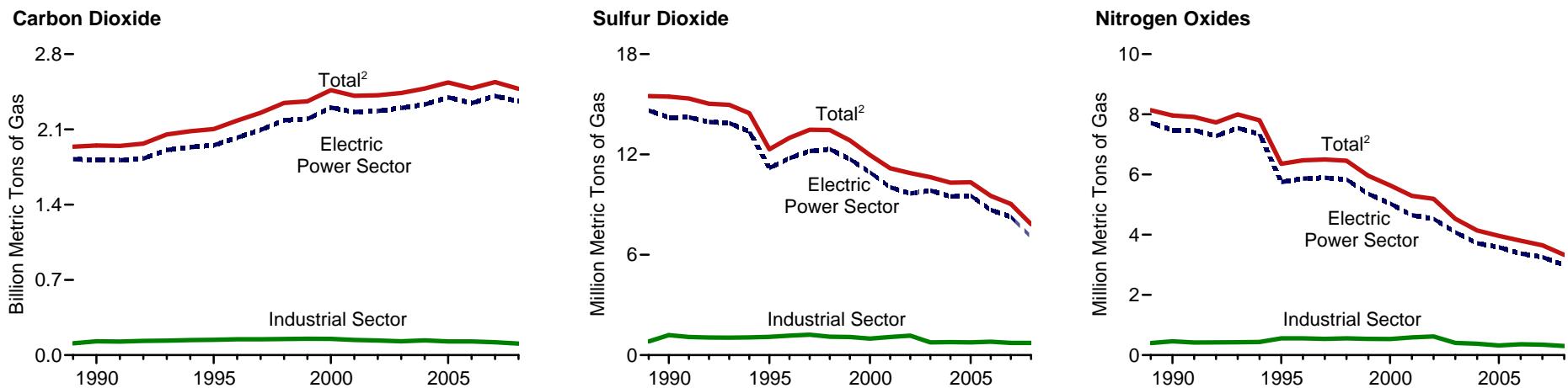
Sources: U.S. Energy Information Administration (EIA), *Emissions of Greenhouse Gases in the United States 2008* (December 2009), Table 21; and EIA, Office of Integrated Analysis and Forecasting, estimates.

**Figure 12.7 Emissions From Energy Consumption for Electricity Generation and Useful Thermal Output**

**Emissions by Type of Generating Unit, 2008**



**Emissions by Sector, 1989-2008**



<sup>1</sup> For carbon dioxide: municipal solid waste from non-biogenic sources; tire-derived fuel, and geothermal. For sulfur dioxide and nitrogen oxides: blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels; wood and wood-derived fuels; municipal solid waste, landfill gas, sludge waste, tires, agricultural byproducts, and other biomass; and chemicals, hydrogen, pitch, sulfur, and tar coal.

<sup>2</sup> Includes Commercial Sector.  
(s)=Less than 0.05 million metric tons.  
Sources: Tables 12.7a-12.7c.

**Table 12.7a Emissions From Energy Consumption for Electricity Generation and Useful Thermal Output:  
Total (All Sectors), 1989-2008** (Sum of Tables 12.7b and 12.7c; Thousand Metric Tons of Gas)

Year	Carbon Dioxide <sup>1</sup>						Sulfur Dioxide					Nitrogen Oxides				
	Coal <sup>2</sup>	Natural Gas <sup>3</sup>	Petroleum <sup>4</sup>	Geo-thermal <sup>5</sup>	Non-Biomass Waste <sup>6</sup>	Total	Coal <sup>2</sup>	Natural Gas <sup>3</sup>	Petroleum <sup>4</sup>	Other <sup>7</sup>	Total	Coal <sup>2</sup>	Natural Gas <sup>3</sup>	Petroleum <sup>4</sup>	Other <sup>7</sup>	Total
1989	R1,569,402	R218,378	R145,387	R363	R5,587	R1,939,117	14,469	1	984	39	15,493	7,281	495	269	93	8,136
1990	R1,558,113	R233,846	R119,570	R384	R7,485	R1,949,397	14,281	1	937	243	15,462	7,119	513	208	122	7,961
1991	R1,587,870	R238,078	R111,344	R398	R8,442	R1,946,131	14,240	1	856	246	15,342	7,109	498	193	113	7,913
1992	R1,612,632	R248,143	R96,633	R400	R10,047	R1,967,855	14,060	1	704	264	15,030	6,975	477	158	119	7,728
1993	R1,682,814	R250,405	R108,196	R415	R10,396	R2,052,225	13,843	1	851	271	14,966	7,225	475	173	124	7,997
1994	R1,692,462	R276,301	R102,854	R384	R11,164	R2,083,165	13,398	1	794	279	14,472	7,005	513	159	124	7,801
1995	R1,715,103	R298,601	R77,050	R329	R11,964	R2,103,048	11,188	2	826	298	12,314	5,136	653	332	234	6,355
1996	R1,806,730	R277,856	R84,045	R360	R12,697	R2,181,688	11,811	1	876	R304	12,991	5,307	577	352	238	6,474
1997	R1,853,405	R293,139	R93,554	R374	R13,311	R2,253,783	12,211	1	965	303	13,480	5,322	619	326	233	6,500
1998	R1,881,697	R327,456	R123,659	R375	R12,774	R2,345,962	12,012	1	1,162	289	R13,464	5,123	700	395	241	6,459
1999	R1,888,460	R343,090	R115,882	R381	R12,738	R2,360,551	11,453	R1	1,101	288	12,843	4,687	632	391	245	5,955
2000	R1,979,815	R363,526	R108,550	R362	R12,297	R2,464,550	10,729	R1	933	300	11,963	4,370	614	404	250	5,638
2001	R1,914,324	R367,146	R117,256	R353	R12,950	R2,412,030	9,905	2	1,002	265	11,174	4,096	631	294	268	5,290
2002	R1,931,976	R378,950	R91,120	R372	R14,908	R2,417,327	9,786	2	773	321	R10,881	4,057	625	225	287	5,194
2003	R1,966,841	R345,119	R112,076	R371	R13,932	R2,438,338	9,688	2	717	239	10,646	3,607	453	240	232	4,532
2004	R1,982,570	R367,112	R115,811	R381	R14,097	R2,479,971	9,437	2	633	237	10,309	3,286	416	225	217	4,143
2005	R2,021,451	R383,461	R117,115	R377	R14,270	R2,536,675	9,499	2	R587	251	10,340	3,135	383	221	222	3,961
2006	R1,993,996	R404,278	R68,006	R374	R15,174	R2,481,829	8,867	2	427	227	9,524	2,996	399	164	240	3,799
2007	R2,022,577	R434,536	R67,790	R376	R14,527	R2,539,805	8,389	R3	422	227	9,042	2,870	382	157	242	3,650
2008	1,994,993	419,601	47,898	384	14,336	2,477,213	7,351	3	250	225	7,830	2,680	351	75	225	3,330

<sup>1</sup> Metric tons of carbon dioxide can be converted to metric tons of carbon equivalent by multiplying by 12/44.

<sup>2</sup> Anthracite, bituminous coal, subbituminous coal, lignite, waste coal, and synthetic coal.

<sup>3</sup> Natural gas, plus a small amount of supplemental gaseous fuels.

<sup>4</sup> Distillate fuel oil, residual fuel oil, petroleum coke, jet fuel, kerosene, other petroleum, and waste oil.

<sup>5</sup> Carbon dioxide in geothermal steam.

<sup>6</sup> Municipal solid waste from non-biogenic sources, and tire-derived fuel.

<sup>7</sup> Blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels;

wood and wood-derived fuels; municipal solid waste, landfill gas, sludge waste, tires, agricultural byproducts, and other biomass; and chemicals, hydrogen, pitch, sulfur, and tar coal.

R=Revised.

Notes: • Data are for emissions from energy consumption for electricity generation and useful thermal output. • See "Useful Thermal Output" in Glossary. • Totals may not equal sum of components due to independent rounding.

Web Page: For related information, see <http://www.eia.gov/fuelelectric.html>.

Sources: Tables 12.7b and 12.7c.

**Table 12.7b Emissions From Energy Consumption for Electricity Generation and Useful Thermal Output:  
Electric Power Sector, 1989-2008** (Subset of Table 12.7a; Thousand Metric Tons of Gas)

Year	Carbon Dioxide <sup>1</sup>						Sulfur Dioxide					Nitrogen Oxides				
	Coal <sup>2</sup>	Natural Gas <sup>3</sup>	Petroleum <sup>4</sup>	Geo-thermal <sup>5</sup>	Non-Biomass Waste <sup>6</sup>	Total	Coal <sup>2</sup>	Natural Gas <sup>3</sup>	Petroleum <sup>4</sup>	Other <sup>7</sup>	Total	Coal <sup>2</sup>	Natural Gas <sup>3</sup>	Petroleum <sup>4</sup>	Other <sup>7</sup>	Total
1989	R1,516,150	R169,649	R133,535	R363	R4,362	R1,824,060	13,815	1	810	7	14,633	7,055	390	246	25	7,717
1990	R1,529,951	R177,227	R101,791	R384	R5,792	R1,815,145	13,576	1	628	13	14,218	6,878	390	175	36	7,480
1991	R1,530,339	R180,537	R95,143	R398	R7,202	R1,813,619	13,590	1	621	15	14,227	6,886	384	165	42	7,476
1992	R1,552,442	R187,725	R79,149	R400	R8,471	R1,828,188	13,375	1	559	12	13,946	6,749	359	128	46	7,282
1993	R1,621,465	R188,286	R90,407	R415	R8,574	R1,909,148	13,133	1	735	13	13,882	6,996	357	143	49	7,544
1994	R1,629,449	R211,149	R85,009	R384	R9,309	R1,935,299	12,695	1	665	11	13,373	6,777	390	128	47	7,343
1995	R1,651,892	R228,675	R61,064	R329	R10,009	R1,951,968	10,573	1	581	34	11,189	4,974	402	282	95	5,754
1996	R1,742,763	R205,250	R66,117	R360	R9,929	R2,024,418	11,129	1	617	32	11,779	5,144	326	301	96	5,866
1997	R1,789,204	R220,174	R75,119	R374	R10,332	R2,095,203	11,515	1	653	36	12,205	5,157	370	269	98	5,894
1998	R1,819,497	R249,836	R105,638	R375	R10,165	R2,185,511	R11,373	1	911	37	12,321	4,965	431	337	103	5,836
1999	R1,826,026	R262,455	R97,937	R381	R10,267	R2,197,067	10,843	1	836	42	11,722	4,535	381	332	109	5,357
2000	R1,916,892	R283,034	R92,260	R362	R10,144	R2,302,692	10,140	1	746	45	10,932	4,225	338	367	111	5,040
2001	R1,856,326	R291,101	R102,903	R353	R10,896	R2,261,580	9,281	2	754	5	10,041	3,878	425	253	96	4,652
2002	R1,872,407	R307,455	R78,828	R372	R12,749	R2,271,811	9,106	2	R549	16	9,672	3,813	425	187	104	4,528
2003	R1,910,656	R279,300	R98,219	R371	R11,443	R2,299,988	9,255	2	579	13	9,849	3,496	282	207	98	4,082
2004	R1,922,932	R297,782	R100,249	R381	R11,165	R2,332,508	8,991	2	493	9	9,495	3,183	241	193	101	3,717
2005	R1,963,866	R320,545	R102,546	R377	R11,248	R2,398,582	9,071	2	461	10	9,543	3,051	243	189	103	3,585
2006	R1,937,791	R339,557	R55,373	R374	R11,529	R2,344,625	8,416	2	264	8	8,690	2,902	230	135	107	3,374
2007	R1,970,426	R373,268	R55,557	R376	R11,293	R2,410,920	8,002	3	265	9	8,279	2,781	236	130	112	3,259
2008	1,944,450	363,749	40,450	384	11,614	2,360,646	6,909	2	146	8	7,065	2,578	230	58	124	2,990

<sup>1</sup> Metric tons of carbon dioxide can be converted to metric tons of carbon equivalent by multiplying by 12/44.

<sup>2</sup> Anthracite, bituminous coal, subbituminous coal, lignite, waste coal, and synthetic coal.

<sup>3</sup> Natural gas, plus a small amount of supplemental gaseous fuels.

<sup>4</sup> Distillate fuel oil, residual fuel oil, petroleum coke, jet fuel, kerosene, other petroleum, and waste oil.

<sup>5</sup> Carbon dioxide in geothermal steam.

<sup>6</sup> Municipal solid waste from non-biogenic sources, and tire-derived fuel.

<sup>7</sup> Blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels; wood and wood-derived fuels; municipal solid waste, landfill gas, sludge waste, tires, agricultural byproducts, and other biomass; and chemicals, hydrogen, pitch, sulfur, and tar coal.

R=Revised.

Notes: • There are small differences in carbon dioxide emissions values between this table and Table 12.2 due to differences in the methodologies for calculating the data. • Data are for emissions from energy

consumption for electricity generation and useful thermal output. • The electric power sector comprises electricity-only and combined-heat-and-power (CHP) plants within the NAICS 22 category whose primary business is to sell electricity, or electricity and heat, to the public. • See Table 12.7c for commercial and industrial CHP and electricity-only data. • See Note 2, "Classification of Power Plants Into Energy-Use Sectors," at end of Section 8. • See "Useful Thermal Output" in Glossary. • Totals may not equal sum of components due to independent rounding.

Web Page: For related information, see <http://www.eia.gov/fuelelectric.html>.

Sources: **Carbon Dioxide:** U.S. Energy Information Administration (EIA) estimates based on Form EIA-923, "Power Plant Operations Report" (and predecessor forms). **Sulfur Dioxide and Nitrogen Oxides:** EIA estimates based on Form EIA-923, "Power Plant Operations Report" (and predecessor forms). Data were adjusted by the Environmental Protection Agency's Continuous Emissions Monitoring System.

**Table 12.7c Emissions From Energy Consumption for Electricity Generation and Useful Thermal Output:  
Commercial and Industrial Sectors, 1989-2008** (Subset of Table 12.7a; Thousand Metric Tons of Gas)

Year	Carbon Dioxide <sup>1</sup>						Sulfur Dioxide					Nitrogen Oxides				
	Coal <sup>2</sup>	Natural Gas <sup>3</sup>	Petroleum <sup>4</sup>	Geo-thermal <sup>5</sup>	Non-Biomass Waste <sup>6</sup>	Total	Coal <sup>2</sup>	Natural Gas <sup>3</sup>	Petroleum <sup>4</sup>	Other <sup>7</sup>	Total	Coal <sup>2</sup>	Natural Gas <sup>3</sup>	Petroleum <sup>4</sup>	Other <sup>7</sup>	Total
<b>Commercial Sector <sup>8</sup></b>																
1989	R2,314	R1,542	R637	—	R804	R5,298	37	(s)	5	1	43	9	3	2	3	17
1990	R2,412	R2,294	R706	—	R959	R6,371	39	(s)	4	1	45	10	6	1	4	21
1991	R2,675	R2,287	R544	—	R1,014	R6,520	32	(s)	3	1	35	10	6	1	4	21
1992	R2,546	R2,787	R474	—	R1,258	R7,064	32	(s)	3	1	35	10	7	1	4	21
1993	R2,982	R3,315	R616	—	R1,285	R8,199	40	(s)	3	1	44	12	7	1	4	24
1994	R2,926	R3,722	R654	—	R1,292	R8,594	39	(s)	3	(s)	42	11	8	1	4	24
1995	R3,100	R4,070	R509	—	R1,462	R9,141	30	(s)	3	3	35	8	20	6	11	45
1996	R3,633	R4,369	R534	—	R2,023	R10,558	40	(s)	3	4	47	9	23	4	14	50
1997	R3,864	R4,654	R719	—	R2,274	R11,511	43	(s)	3	6	51	10	34	7	14	65
1998	R3,336	R4,707	R835	—	R2,075	R10,953	37	(s)	5	4	45	10	35	5	16	66
1999	R3,463	R4,535	R742	—	R2,008	R10,747	34	(s)	4	4	42	9	28	4	17	57
2000	R3,627	R4,605	R740	—	R1,684	R10,656	33	(s)	4	7	43	8	38	4	16	65
2001	R3,361	R4,280	R839	—	R1,418	R9,898	43	(s)	4	2	48	13	19	2	16	50
2002	R3,018	R4,035	R571	—	R1,520	R9,145	41	(s)	2	2	46	13	20	2	13	48
2003	R3,894	R3,222	R683	—	R1,706	R9,505	32	(s)	3	1	36	9	16	5	15	45
2004	R4,009	R3,916	R920	—	R1,962	R10,807	30	(s)	3	2	35	8	18	8	16	49
2005	R4,022	R3,701	R759	—	R1,897	R10,378	33	(s)	3	1	36	9	24	6	15	54
2006	R3,899	R3,686	R445	—	R1,946	R9,975	33	(s)	3	1	36	9	35	3	17	64
2007	R3,984	R3,800	R363	—	R1,635	R9,783	33	(s)	3	1	37	10	16	2	16	44
2008	4,145	3,591	310	—	1,953	9,999	32	(s)	1	(s)	33	9	14	1	16	40
<b>Industrial Sector <sup>9</sup></b>																
1989	R50,937	R47,187	R11,215	—	R420	R109,760	616	(s)	169	32	817	218	100	21	63	403
1990	R55,750	R54,325	R17,072	—	R734	R127,881	666	(s)	304	229	1,199	233	116	31	80	461
1991	R54,856	R55,254	R15,657	—	R225	R125,993	618	(s)	232	230	1,080	215	108	27	66	416
1992	R57,644	R57,631	R17,009	—	R319	R132,603	655	(s)	143	251	1,049	218	110	29	67	425
1993	R58,367	R58,803	R17,172	—	R536	R134,878	671	(s)	113	257	1,041	219	110	70	429	
1994	R60,087	R61,430	R17,192	—	R563	R139,271	664	(s)	126	267	1,057	219	114	30	71	435
1995	R60,112	R65,856	R15,477	—	R493	R141,939	585	(s)	243	262	1,090	154	231	43	128	556
1996	R60,334	R68,237	R17,394	—	R746	R146,711	642	(s)	256	268	1,166	154	228	48	128	558
1997	R60,337	R68,311	R17,716	—	R704	R147,069	653	(s)	309	261	1,223	155	215	50	121	541
1998	R58,864	R72,914	R17,186	—	R535	R149,498	603	(s)	247	248	1,099	148	234	53	121	557
1999	R58,971	R76,100	R17,204	—	R463	R152,738	576	(s)	260	243	1,080	144	223	55	120	541
2000	R59,297	R75,887	R15,549	—	R469	R151,202	556	(s)	184	248	988	138	238	34	123	533
2001	R54,637	R71,765	R13,514	—	R636	R140,552	581	(s)	245	259	1,085	206	187	39	156	587
2002	R56,551	R67,460	R11,720	—	R639	R136,370	639	(s)	221	303	1,163	231	181	36	170	618
2003	R52,290	R62,598	R13,174	—	R783	R128,845	401	(s)	135	224	761	102	155	28	119	404
2004	R55,628	R65,413	R14,643	—	R970	R136,655	415	(s)	136	227	779	95	157	25	100	376
2005	R53,563	R59,216	R13,810	—	R1,126	R127,715	395	(s)	124	241	760	75	117	27	104	322
2006	R52,306	R61,035	R12,188	—	R1,700	R127,229	419	(s)	161	218	798	86	134	26	117	362
2007	R48,166	R57,467	R11,870	—	R1,599	R119,103	353	1	154	217	726	79	129	26	113	346
2008	46,399	52,261	7,139	—	769	106,568	411	1	103	217	731	93	107	16	84	300

<sup>1</sup> Metric tons of carbon dioxide can be converted to metric tons of carbon equivalent by multiplying by 12/44.

<sup>2</sup> Anthracite, bituminous coal, subbituminous coal, lignite, waste coal, and synthetic coal.

<sup>3</sup> Natural gas, plus a small amount of supplemental gaseous fuels.

<sup>4</sup> Distillate fuel oil, residual fuel oil, petroleum coke, jet fuel, kerosene, other petroleum, and waste oil.

<sup>5</sup> Carbon dioxide in geothermal steam.

<sup>6</sup> Municipal solid waste from non-biogenic sources, and tire-derived fuel.

<sup>7</sup> Blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels; wood and wood-derived fuels; municipal solid waste, landfill gas, sludge waste, tires, agricultural byproducts, and other biomass; and chemicals, hydrogen, pitch, sulfur, and tar coal.

<sup>8</sup> Commercial combined-heat-and-power (CHP) and commercial electricity-only plants.

<sup>9</sup> Industrial combined-heat-and-power (CHP) and industrial electricity-only plants.

R=Revised. — = No data reported. (s)=Less than 0.5 thousand metric tons.

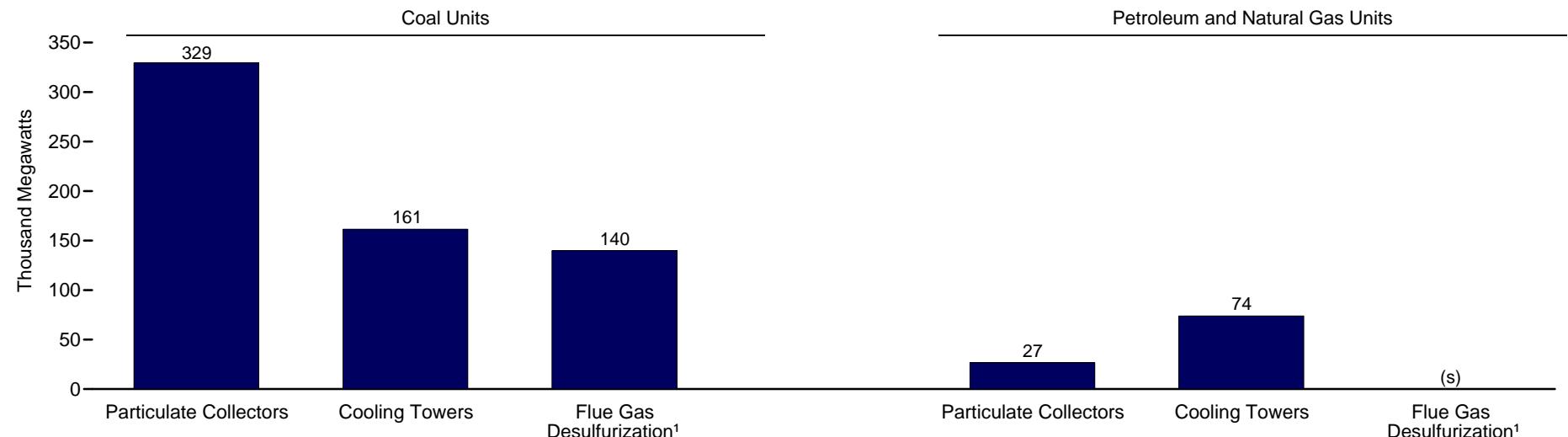
Notes: • Data are for emissions from energy consumption for electricity generation and useful thermal output. • See Table 12.7b for electric power sector data. • See Note 2, "Classification of Power Plants Into Energy-Use Sectors," at end of Section 8. • See "Useful Thermal Output" in Glossary. • Totals may not equal sums of components due to independent rounding.

Web Page: For related information, see <http://www.eia.gov/fuelelectric.html>.

Sources: **Carbon Dioxide:** U.S. Energy Information Administration (EIA) estimates based on Form EIA-923, "Power Plant Operations Report" (and predecessor forms). **Sulfur Dioxide and Nitrogen Oxides:** EIA estimates based on Form EIA-923, "Power Plant Operations Report" (and predecessor forms). Data were adjusted by the Environmental Protection Agency's Continuous Emissions Monitoring System.

**Figure 12.8 Installed Nameplate Capacity of Fossil Fuel Steam-Electric Generators With Environmental Equipment**

**By Fuel and Equipment Type, 2008**



<sup>1</sup> Also called "scrubbers."

<sup>2</sup> Through 2000, data are for electric utility plants with fossil-fueled steam-electric capacity of 100 megawatts or greater. Beginning in 2001, data are for electric utility and unregulated generating plants (independent power producers, commercial plants, and industrial plants) in operating or standby status, with fossil-fueled steam-electric capacity of 100 megawatts or greater, or combustible-renewable steam electric capacity of 10 megawatts or greater.

(s)=Less than 0.5 thousand megawatts.

Note: • Components are not additive because some generators are included in more than one category.

Source: Table 12.8.

**Table 12.8 Installed Nameplate Capacity of Fossil-Fuel Steam-Electric Generators With Environmental Equipment, 1985-2008** (Megawatts)

Year	Coal				Petroleum and Natural Gas				Total			
	Particulate Collectors	Cooling Towers	Flue Gas Desulfurization (Scrubbers)	Total <sup>1</sup>	Particulate Collectors	Cooling Towers	Flue Gas Desulfurization (Scrubbers)	Total <sup>1</sup>	Particulate Collectors <sup>1</sup>	Cooling Towers <sup>1</sup>	Flue Gas Desulfurization (Scrubbers) <sup>1</sup>	Total <sup>1</sup>
1985	302,056	120,591	56,955	304,706	36,054	28,895	65	62,371	338,110	149,486	57,020	367,078
1986	308,566	126,731	63,735	311,217	34,258	27,919	65	59,618	342,825	154,650	63,800	370,835
1987	311,043	127,875	65,688	312,885	33,431	27,912	65	58,783	344,474	155,786	65,753	371,668
1988	311,776	129,366	67,156	313,618	34,063	27,434	65	58,937	345,839	156,800	67,221	372,555
1989	313,680	131,701	67,469	315,521	33,975	28,386	65	59,736	347,655	160,087	67,534	375,257
1990	315,681	134,199	69,057	317,522	33,639	28,359	65	59,372	349,319	162,557	69,122	376,894
1991	319,046	135,565	70,474	319,110	33,864	29,067	260	59,773	352,910	164,632	70,734	378,883
1992	319,856	136,266	71,336	319,918	33,509	28,764	195	59,116	353,365	165,030	71,531	379,034
1993	318,188	135,885	71,106	318,251	32,620	28,922	—	58,580	350,808	164,807	71,106	376,831
1994	319,485	137,266	80,617	319,776	31,695	28,186	—	57,123	351,180	165,452	80,617	376,899
1995	320,685	138,108	84,677	320,749	30,513	27,187	—	54,942	351,198	165,295	84,677	375,691
1996	321,805	139,065	85,842	321,869	30,349	27,685	—	55,275	352,154	166,749	85,842	377,144
1997	320,646	138,120	86,605	320,710	31,422	28,766	—	56,485	352,068	166,886	86,605	377,195
1998	321,082	139,082	87,783	321,353	30,708	27,814	—	55,764	351,790	166,896	87,783	377,117
1999	324,109	146,377	89,666	331,379	29,371	29,142	—	55,812	353,480	175,520	89,666	387,192
2000	321,636	146,093	89,675	328,741	31,090	29,427	—	57,697	352,727	175,520	89,675	386,438
2001 <sup>2</sup>	329,187	154,747	97,804	329,187	31,575	34,649	184	61,634	360,762	189,396	97,988	390,821
2002	329,459	154,750	98,363	329,459	29,879	45,920	310	72,008	359,338	200,670	98,673	401,341
2003	328,587	155,158	99,257	328,587	29,422	55,770	310	81,493	358,009	210,928	99,567	409,954
2004	328,506	157,968	101,182	328,506	27,402	57,082	310	81,450	355,782	214,989	101,492	409,769
2005	328,720	158,493	101,338	328,720	27,005	59,214	310	83,307	355,599	217,646	101,648	411,840
2006	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2007	328,194	159,388	118,739	328,501	26,521	69,993	310	93,586	354,572	229,199	119,049	421,781
2008	329,332	161,424	139,877	329,746	26,604	73,792	386	97,515	355,764	234,920	140,263	426,812

<sup>1</sup> Components are not additive because some generators are included in more than one category.

<sup>2</sup> Through 2000, data are for electric utility plants with fossil-fueled steam-electric capacity of 100 megawatts or greater. Beginning in 2001, data are for electric utility and unregulated generating plants (independent power producers, commercial plants, and industrial plants) in operating or standby status, with fossil-fueled steam-electric capacity of 10 megawatts or greater.

NA=Not available. — = No data reported.

Note: See "Particulate Collectors," "Cooling Tower," and "Flue Gas Desulfurization" in Glossary.

Web Page: For related information, see <http://www.eia.gov/fuelelectric.html>.

Sources: • 1985-1996—U.S. Energy Information Administration (EIA), Form EIA-767, "Steam-Electric Plant Operation and Design Report." • 1997-2005—EIA, *Electric Power Annual 2008* (January 2010), Table 3.10, and Form EIA-767, "Steam-Electric Plant Operation and Design Report." • 2007 and 2008—EIA, *Electric Power Annual 2008* (January 2010), Table 3.10, and Form EIA-860, "Annual Electric Generator Report."

## Environment

### Note. Accounting for Carbon Dioxide Emissions From Biomass Energy

**Combustion.** Carbon dioxide (CO<sub>2</sub>) emissions from the combustion of biomass to produce energy are excluded from the energy-related CO<sub>2</sub> emissions reported in the *Annual Energy Review*. According to current international convention (see the Intergovernmental Panel on Climate Change's "2006 IPCC Guidelines for National Greenhouse Gas Inventories"), carbon released through biomass combustion is excluded from reported energy-related emissions. The release of carbon from biomass combustion is assumed to be balanced by the uptake of carbon when the feedstock is grown, resulting in zero net emissions over some period of time. (This is not to say that biomass energy is carbon-neutral. Energy inputs are required in order to grow, fertilize, and harvest the feedstock and to produce and process the biomass into fuels.)

However, analysts have debated whether increased use of biomass energy may result in a decline in terrestrial carbon stocks, leading to a net positive release of carbon rather than the zero net release assumed by its exclusion from reported energy-related emissions. For example, the clearing of forests for biofuel crops could result in an initial release of carbon that is not fully recaptured in subsequent use of the land for agriculture.

To reflect the potential net emissions, the international convention for greenhouse gas inventories is to report biomass emissions in the category "agriculture, forestry, and other land use," usually based on estimates of net changes in carbon stocks over time.

This indirect accounting of CO<sub>2</sub> emissions from biomass can potentially lead to confusion in accounting for and understanding the flow of CO<sub>2</sub> emissions within energy and non-energy systems. In recognition of this issue, reporting of CO<sub>2</sub> emissions from biomass combustion alongside other energy-related CO<sub>2</sub> emissions offers an alternative accounting treatment. It is important, however, to avoid misinterpreting emissions from fossil energy and biomass energy sources as necessarily additive. Instead, the combined total of direct CO<sub>2</sub> emissions from biomass and energy-related CO<sub>2</sub> emissions implicitly assumes that none of the carbon emitted was previously or subsequently reabsorbed in terrestrial sinks or that other emissions sources offset any such sequestration.

According to the EIA's *Annual Energy Outlook 2010*, including direct CO<sub>2</sub> emissions from biomass energy combustion would increase the 2008 total for energy-related CO<sub>2</sub> emissions by 353 million metric tons (6.1 percent). If in fact these emissions are all offset by biological sequestration, the net emissions would be zero as assumed in EIA's totals.